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A PRELIMINARY STUDY OF THE ARANEAE THERAPHOSAE OF CALIFORNIA.

CHAS. PIPER SMITH.

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Comparatively little work has been done upon the trapdoor spiders and tarantulas of North America. Popularly, the trapdoor species, Bothriocyrtum californicum (Cteniza) and the tarantulas, Eurypelma (Mygale hentzi, etc.), are well-known from the numerous specimens put up and sold by natural history dealers; but our various other forms are practically unknown to most zoologists and entomologists, and have received very little attention.

N. M. Hentz, the pioneer of American arachnology, writing between the years 1821 and 1850, described six species of Araneae theraphosae, all from the South-eastern States. Two of these are male and female of one species, however, and are the same as one of the five species attributed to North America by H. Lucas, a Frenchman, whose papers appeared from 1834 to 1845. Walckenaer, also a Frenchman, in a work published in 1837, named four North American forms, only one of which goes by his name today. In 1852, Girard published Mygale hentzi. Rev. O. P.

Cambridge, of England, published Cteniza californica in 1874, and nine years later, Atypoides riversi. Anton Ausserer, of Vienna, has published (1871–1875) four species of Eurypelma, one the same as E. hentzi Girard, and two from the manuscript of Doleschall. Prof. Geo. Atkinson, of Cornell University, was the next American to add to the literature upon these forms, describing seven species in 1886, all from Virginia and North Carolina. At least two of these had been already described. Geo. Marx (1888) and Nathan Banks (1896), both of Washington, D. C., have each described one species. Eugene Simon, of Paris, who has made a more comprehensive study of the spider fauna of the world than any other student, has described eighteen North American species. Cambridge and Atkinson have added to their descriptions accounts of the ecology of the forms they describe; but many of the species have not had their habits and haunts investigated and recorded, indeed many of them, apparently, have not been collected, or recorded since the original descriptions appeared.

Four listings of the North American species of the Araneae theraphosae have been made. Geo. Marx (1889), in his "Catalogue of the Described Araneae of Temperate North America," lists 29 species. Simon, in his "Liste des Especes de la Famille des Avicullariides qui habitent l'Amerique du Nord" (1891), enumerates 37 species, 18 of which are his own, and 13 of which are therein described for the first time. Nathan Banks (1892), in his paper entitled, "Our Atypidae and Theraphosidae", recognizes but 23 species, he evidently not having considered Simon's paper of the preceding year. Lastly, J. H. Comstock (1903) in his publication, "A Classification of North American Spiders," lists 36 species; or 37 if Simon's reference to an Aviculariа from San Diego be considered.

Of these 37 forms, 18 are attributed to the Pacific Coast, 17 to California. All have been described by men situated in the Eastern United States or in Europe, from material sent to them. It is no wonder, therefore, that our species have been described mostly from meagre and young material, and the ecology of so few has been recorded.

The following list sums up the species reported from California, embodying the redistribution of certain forms, as found necessary from the study of my material:

Avicularíidae
- Ctenizinae
  - Hebestatis theveneti Simon (Cycloscosmia)
  - Bothriocyrtum californicum, Cambr. (Cteniza)
  - Eutychides versicolor, Simon (Actinoxia)
  - Aptostichus atomarius Simon
  - Aptostichus clathratus Simon
  - Aptostichus stanfordianus sp. nov.
  - Amblyocarenum talpa Simon (Cyrtauchenius)
- Aviculariinae
  - Avicularia sp. (?)
  - Eurypelma californica Auss.
  - Eurypelma leiogaster Auss.
  - Eurypelma steindachneri Auss.
  - Eurypelma rileyi Marx.
  - Eurypelma marxi Simon
- Diplurniae
  - Brachythele longitarsis Simon
  - Brachythele theveneti Simon

Atypidae
- Atypoides riversi Cambr.
- Aliatypus californicus, Banks (Atypoides)
- Hexura picea Simon.

Marx and Banks have followed the older classification of Ausserer. Comstock has, however, followed the newer classification of Simon, as given in his "Histoire Naturelle des Araignees," Vol. I (1892, as to part dealing with the Araneae theraphosae). I likewise, follow Simon, in general; but in the supplement of this work, published in 1903, Simon makes certain changes in classification, which concern certain of our North American forms, affecting Comstock's tables, and attracting special attention to one of the species found about Stanford University.

The family Atypidae, formerly, was divided into three subfamilies, the Brachybothriinae, Hexurinae, and Atypinae, each comprising two genera. All three sub-families are represented in North America. All the rest of our Araneae theraphosae were placed in the family Avicularíidae. By Simon's new arrangement, the family Atypidae is limited to the two genera of the old "Atypinae," the other two sub-families being transferred to the Avicularíidae; the change, however, not at all affecting the

sequence established earlier. The old family Atypidae was characterized by the elevated position of the anal tubercule, the normal number of the spinnerets being six (the genus Brachybothrium excepted), and the lower border of the chelicerae being narrow and without a distinct groove for the reception of the fang. The family as now limited, is distinguished by the great development of the coxal lobe of the pedipalps, the four pairs of sternal impressions, and the presence of a conductor on each genital bulb of the male. The Brachybothriinae have no coxal lobes on the pedipalps, no suggestion of a conductor on the genital bulbs; but have a rake on the chelicerae, the thoracic furrow is longitudinal, and the sternal impressions are four in Brachybothrium, six in Atypoides. The Hexurinae have only two sternal impressions and no rake, the thoracic pit is longitudinal, there is a suggestion of a coxal lobe on the pedipalps and the genital bulbs have a short spur, probably analogous to the conductor of the Atypinae.

The species which becomes of special interest in connection with these groups of Simon's, is Banks' Atypoides californica. The male of this species seems to be unknown to science, so I take pleasure in reporting the finding of two males, October, 1907, in the immediate vicinity of Stanford University. A casual comparison of these specimens with the drawings of the male of Atypoides riversi Cambr., shows marked differences between the two species, and a careful study of the facts at hand, shows the necessity of the formation of a new genus to accomodate the species described by Banks. The female of this species is quite close in structure to the female of Atypoides riversi, having a rake and six sternal impressions; but the thoracic pit is round, not longitudinal. The male has a rake, the thoracic pit round, short coxal lobes on the pedipalps, much as in Hexura, and also has a conductor on each genital bulb, nearly the full length of the bulb. How it differs otherwise from Atypoides will be discussed in the proper place below. In truth, the female of Aliatypus, as the new genus will be called, seems to merit a position nearer the Brachybothriinae, while the male, in certain respects, belongs rather between the Hexurinae and the Atypinae. Such a condition of affairs makes a readjustment of Simon's classification of these forms worthy of consideration. The affinities of Aliatypus toward Atypus, however, are thru "secondary sexual characters" in the male, which, if of as little weight in classification as some

authors argue, are not so important as the characters, common to both sexes, placing the genus between Atypoides and Hexura.

Altho I have not studied specimens of Brachybothrium, Hexura and Atypus, and have not seen the genus Scotinoecus, which Simon considers as linking Brachybothrium to the Diplurinae, it seems to me that Simon's Atypidae of 1892 is more worthy of recognition as a family than his limited Atypidae of 1903. Accepting, accordingly, the older Atypidae as a family, the group logically admits separation into five natural smaller groups, whether of sub-family or tribal rank is not important. Arranged in the form of a key, these groups may be characterized as follows:

Spinnerets 4, sternal impressions 4, chelicerae with a rake, no coxal lobe, thoracic pit longitudinal..... **Brachybothrium**(1)
Spinnerets 6:
  Chelicerae with a rake, sternal impressions 6, coxal lobe none or slightly produced in male.
    Coxal lobe none, thoracic pit longitudinal, bulb of male without conductor ..... **Atypoides** (2)
    Coxal lobe apparent in male, thoracic pit round, bulb with long slender conductor..... **Aliatypus** (3)
  Chelicerae without a rake.
    Coxal lobe small, sternal impressions 2, thoracic pit longitudinal, bulb with a stout spur..... **Hexura** (4)
      Mecicobothrium
    Coxal lobe very large, sternal impressions 8, thoracic pit transverse, bulb with long conductor..... **Atypus** (5)
      Calommata

One other difficulty that comes up in following Simon's late classification is in regard to his groups Cyrtauchenieae and Amblyocarenieae, of the sub-family Ctenizinae. These groups are separated from each other upon the basis of the relative size of the posterior sternal impressions and the relations of these two impressions to each other and to the margin of the sternum. As to these characters, I find that in two of the species of the Ctenizinae found in this vicinity, that the young answer the requirements of one group while the adults claim admission to the other group. In truth, the sternal impressions seem to be characters that vary according to the age or size of the individual, at least in some species, and should be used with caution in classification. This point will be taken up further, in the discussion of the species concerned.

From the number of forms of the Araneae theraphosae described from California, and with Simon's latest work and Comstock's recent "Classification of North American Spiders" at hand, it was supposed that the species found about Stanford

University could be readily identified, leaving only the life habits of the forms needing investigation. It was soon found, however, that the species collected were far from being easily determined, and developments soon showed that a problem in systematic work was really at hand. Thus it was deemed advisable to press first the solution of the taxonomic questions, even if the biological phases of the problem had to be neglected. Efforts were therefore made to secure good series of all the species obtainable, and in some cases very satisfactory results were obtained.

The territory covered is not extensive, not nearly as much so as desirable, but many days have been spent in careful field work in the immediate vicinity of Stanford University. The mountains west of Stanford have been visited to the extent of the Woodside-Kings Mt. Road, and the ravine west of, and below, King's House, the base of the Woodside–La Honda Road, the Goat-Ranch Canon and the New Grade Road, the Page-Mill Road, and the Los Gatos Canon, from Wrights down. In the Mt. Hamilton Range, the lower portion of the Alum Rock Canon was visited, and material was secured at various points along the Mt. Hamilton Stage-road from San Jose. A special trip was made to Santa Rosa, Sonoma County, as this was then supposed to be the type locality of Simon's Aptostichus clathratus. Material was secured at the base of the hills due east of Petaluma, at White Sulphur Springs, south-east of Santa Rosa, and along the Guerneville-Forestville Road, near the Russian River. Finally, the gulches in the pine forest of the Monterey Peninsula, and the Monterey-Sur County-road, yielded valuable returns for the time spent in that vicinity.

The only way of locating the nests of the spiders is by careful search for the traps or open burrows, in likely places, as learned by experience. Frequently, after a considerable rain, the burrow is deepened and pellets of soil, held together by silken thread, are carried out and piled up near the burrow, such piles being often much more noticeable than the trapdoors, and even more so than the uncovered openings. In moss-covered banks, a very popular resort, the trapdoors are commonly almost beyond discovery by human ken, but frequently a practiced eye may detect a flattened space in a mass of moss which may be lifted up and seen to be a trapdoor. Sometimes the free edge of the door will be quite noticeable to one accustomed to detecting them. In general, they are quite indiscernible to the casual observer,

altho in a conspicuous place. The chimneys, or "turrets," of Atypoides are more or less conspicuous and attract common attention. "Tarantula holes" are well known to almost everyone, where tarantulas occur.

A nest once located, the soil is carefully dug away with a small miner's pick, the details of the measurements, directions, branches (if any), and silk lining being studied and recorded in a field-book, each specimen being given a permanent number and page in the book. The more careful exposing of the burrow is done with a pair of small forceps, with curved points, the pick being used for the rougher digging only. The spider is stored away in a cork-stoppered bottle, a slip of paper bearing the number assigned the individual always being fastened in between the cork and glass. The composition of the trapdoor or turret and its surroundings are usually recorded, and any other notes considered to be of possible interest or use.

In the laboratory, the spiders are put into about 75% alcohol and laid aside for later study, each in a separate vial and under the number given it in the field. Spiders corked up as brought in from the field have been found to be thoroly alive after having been thus confined for a full week, without fresh air. They die very slowly in potassium-cyanide killing bottles. For study they are placed in a watch-crystal and kept under alcohol, or they are laid out on a blotting-paper or white cloth and allowed to dry for half an hour or so, when most of the external structures are studied with a hand-lens, a dissecting, or a compound, microscope; but if left out over an hour, without moistening with a couple of drops of alcohol, the abdomen is apt to shrink, thus deteriorating the specimen. For especially careful study of such portions as the rake of the chelicerae, tarsal claws, etc., dissections carefully mounted in balsam give the most satisfactory results. Even then it is noticed that with such uneven topography as many spiders possess, "things look different" from different angles and much care is necessary to make a series of comparative drawings worth anything.

The following key is given to aid in identifying the species discussed in the remaining pages.

(I) With four spinnerets.
  (1) Chelicerae with a rake
    (a) Tarsi I and II not scopulate..... **Bothriocyrtum**
    (aa) Tarsi I and II densely scopulate
      (b) Coxa P with spinules scattered from base to apex (Plate XIV, fig. 16) ..... **Eutychides**
      (bb) Coxa P with spinules limited to inner basal corner (Plate XIV, fig. 17)..... **Aptostichus**
        (c) Cephlx. distinctly appressed–pubescent, eye-tuber very high (Plate XIV, fig. 31)..... **A. atomarius**
        (cc) Cephlx. apparently glabrous, eye-tuber much lower Plate XIV, figs. 22 and 23)..... **A. stanfordianus**
  (2) Chelicerae without a rake
    (a) Tarsi of legs lacking third claw; abdomen long-setose and short-velvety ..... **Eurypelma**
    (aa) Tarsi of legs with third claw; abdomen short-silky pubescent, not setose..... **Brachythele**
(II) With six spinnerets
    (1) Thoracic pit longitudinal; ♂ without conductor on genital bulb, pedipalps half as long as legs I..... **Atypoides**
    (2) Thoracic pit round; ♂ with conductor on genital bulb and pedipalps as long as legs I..... **Aliatypus**

Bothriocyrtum californicum, Cambr. (Cteniza). In Mogg., Harvesting Ants and Trapdoor Spiders, II (Supp.), 1874.

This is the well-known trapdoor spider of Southern California, whose thick, bevel-edged trapdoor and nest is commonly sold by natural history dealers. The species was probably more or less common in the Santa Clara Valley, before the days of plowing and cultivation. I have been unable to find any trace of it since my searchings began. Dr. Jenkins reports the finding of a nest on his Cedro Cottage premises, sometime about 1890. The specimen is supposed to be deposited with the Entomological Museum of the University, but unfortunately there seems to be no specimen here labeled as such. It may be one of two unlabeled specimens that are here. The only other report that I have come across is in Science, III, 62, Notes and News, p. 476 (1884), which, however, states that a new Cteniza has been found at San Jose, different from the one found in Southern California, and may, indeed, refer to something else. As it gives no reference, the report is probably worthless. Bothriocyrtum, however, probably persists yet in some isolated, uncultivated areas in this county, and may be expected to come to light at any time in the future.

Eutychides versicolor, Simon. (Actinoxia). Act. Soc. Linn. Bord., XLIV, p. 318.

(Plate XIII, figs. 1–19; XIV, figs. 1–16; XVI, figs. 1–2).

Simon's Actinoxia was based upon a very young individual, only 8 mm. long, and is not retainable as a genus. Simon himself

has already recognized this fact, and says: "Le genre Actinoxia sera sans doute à supprimer et à rèunir à Aptostichus, il est basè sur un très jeune individu et ses caractères tiennent peutêtre a l'âge" (Hist. Nat. des Ar. II, Supp., p. 900). I have collected, and have before me, one male and over seventy-five females, ranging in length from 7 to 26 mm., not including several broods of young taken from the nests of the parents, to be mentioned later. A careful study of several individuals, ranging in length from 7 to 12 mm., has satisfied me that I have the species treated as above by Simon. There is a specimen of this form, 14 mm., long, in the collection here, labeled, "Actinoxia versicolor Simon, det. by Banks." The adults, however, cannot be referred to Actinoxia, nor can they be placed in Aptostichus; but their more important and more constant characters conform best to Simon's diagnosis of Eutychides (Ann. Soc. ent. Fr., 1888, p. 213), (Hist. Nat. des Ar., I, p. 109), especially as to the posterior sternal impressions and the armature of the pedipalps. The species seems to be closely related to E. dugesi Simon (Ann. Soc. ent. Fr., 1888, p. 214), but is certainly distinct.

It is the most common trapdoor spider of the Santa Clara Valley, the foothills and canons on either side. It is the only form that I found while in Sonoma County. I did not find it in the portion of Monterey County visited. Mr. Banks records it from Sierra County (Proc. Cal. Acad. Sci.–Zool. III, 13, 1904, p. 332). It is probably well distributed throughout the Coast Ranges of California.

As both male and female adults are undescribed, I insert rather full descriptions, including generic as well as specific characters.

Adult ♀ (Plate XVI, fig. 1)—Length 26 mm.; cephalothorax 2 mm. long, 7 mm. wide; abdomen 12 mm. long. Cephlx. olivaceous-tawny, cephalic portion darker, margins lighter, apparently glabrous, the scattered minute black setae showing up only under a good lens, posterior margin usually decidedly emarginate; thoracic-pit procurved; a row of much larger, black, cephalad-bent setae along median line of caput, with a narrow glabrous space on each side; caput high, prominent, rapidly narrowing within the middle third, slightly narrowing thru posterior third (Plate XIII, figs. 7–8, 11–12); eye-tuber low, hardly one-fourth as high as long (i. e., longitudinal thickness) (Plate XIV, figs. 5–7); eyes of the Amblyocarenum type, anteriors nearly equidistant, P. L., nearly as large as A. L., P. M. not constant in size or shape (some individual variations shown in Plate XIV, figs. 9–12—fig. 13 showing an abnormal lack of two posterior eyes on one side), A. L. and A. M. dark blue-gray, P. L. dull yellowish, P. M. shining silvery-white. Chelicerae dark reddish, long setose at the apex with attenuating tongues of setose areas reaching to the base above (Plate XIII, figs. 11–12), with a slight obtuse process at the apex within (more noticeable if mounted in balsam) rake (Plate XIII, figs. 15–18) of many teeth, but only four in front, two of which are on the low process, a prominent row of five or more teeth extending up the

inner edge of the chelicerae, (in most young individuals the front row of four are conspicuously larger than the other teeth above and behind—figs. 17–18—and no doubt are responsible for the "Actinoxia" rake described by Simon); fang with a thin scollop-edged median extention within (figs. 16 and 18). Abdomen oval or elliptical, dull tawny, marked with purplish-brown median stripe and transverse bands, very dark, broad, and more-or-less confluent, nearly obscuring the ground-color, or pale and nearly obsolete (Plate XIII, figs. 9–10). Spinnerets as shown in last mentioned figures. Sternum pale tawny, black-setose; three pairs of shallow impressions, posterior pair large, irregularly elongate, oval, ovate, or kidney-shaped (some variations shown in figs. 1–6, Plate XIII), close together and converging cephalad, appearing paler than the surrounding cuticle, because of the absence of fine black setae; anterior pair not apparent in young individuals (fig. 6) and posterior pair smaller, farther from each other and nearer the margin, the younger the individual. Labium a little wider than long, more or less emarginate in front, generally unarmed (67%), but frequently with one to three scattered spinules (33%) (Plate XIII, figs. 13–14). Coxae of pedipalps with many spinules from base to apex of ventral surface, more concentrated cephalo-mesad (Plate XIV, fig. 16; setae not shown); tarsi of pedipalps densely scopulate below, well armed two subapical spines and two others on each margin (71%) (Plate XIII, fig. 15P); next joint armed with numerous spinose setae, but without well-defined arrangements. Legs tawny, or with a decided olivaceous cast; tarsi I and II with two sub-apical spines (86%) metatarsi I and II with four apical spines and two near each margin (78%), frequently, however, one of the apical and the inner of the sub-basal spines are reduced to little more than spinous setae, scarcely distinguishable from the numerous variable setae omitted from the drawing (Plate XIV, fig. 15 I); patella III with a triangular patch of spines, comprising a basal row of from four to six, and four to eight scattered ones above, the number commonly not uniform on the two sides of the same individual (Plate XIV, fig. 14), tibiae III with a few spines above and metatarsi III with marginal rows of spines above and below; femora IV with an apical comb dorso-cephalad, metatarsi IV with a row of spines on each side below and on the inner edge above, with at least two apical spines above and two or more below, tarsi IV with armature very indefinite, the spines varying from none to seven. Tarsal claws usually with one or two larger basal teeth and an inner graduated row of from four to eight smaller teeth, the largest nearest the apex (Plate XIV figs. 1 and 2); occasionally the number is much reduced (Plate XIV, figs. 3 and 4).

The percentages given above are deduced from tabulations made from a careful comparison of forty-three individuals.

Adult ♂ (Plate XVI, fig. 2)—Length 13 mm.; cephalothorax 5 mm. long, 4 mm. wide; abdomen 6 mm. long, 3 mm. wide. Setae everywhere much more robust and blacker than in female. Cephlx. rich tawny (the caput dappled with olive-drab, excepting the glabrous longitudinal bands on either side of the median row of setae), conspicuously bristly, especially the margins, posterior margin scarcely emarginate; thoracic pit recurved, as in female; caput much lower and relatively much smaller than in female, only half as wide as thorax, sides nearly straight, arrangement of setae as in female; eyes and eye-tuber as in female. Chelicerae much smaller and more slender than in female, darker in color; rake of fewer teeth above. Abdomen with median band not in evidence, but transverse bands nearly confluent, the pigment arranged in rings all over the dorsum, but more confluent in the bands; spinnerets conspicuously paler, light yellowish, more slender, the terminal joint relatively longer and nearer size of medial joint. Sternum as in female, outline and impressions well represented by fig. 3, Plate XIII, but the most anterior pair of impressions less apparent. Labium with setae only, no spinules; anterior edge not emarginate. Pedipalps short, less than half as long as legs I (see photo); coxae P with spinules from base to apex, but these less numerous, very slender, almost microscopic, and more confined to the anterior half; tibiae nearly twice as long as the patellae, attenuated toward the apex; bulb nearly simple, the lower surface with a nearly

complete ring running out upon the curved spine (Plate XIII, fig. 19). Legs rich tawny above, dulled by an olive tint over the areas beset with stout black setae, paler below; tarsi I and II unarmed below, scopulate, metatarsi I thinly scopulate, with basal half bent, with four apical spines and a low conical projection near the middle of the outer edge, metatarsi II scopulate, with four apical, one inner lateral, and three outer lateral spines, tibiae I and II with apical and lateral spines (no comb nor spur as in E. guadalupensis) and the numerous spinose setae common to all the joints except the tarsi; tarsi III and IV unarmed, thinly scopulate below, slender setose above, metatarsi III and IV with four apical spines, and two lateral and one median rows of slender spines, tibiae III and IV with several more scattered spines, patellae III and femora IV as in female, but the setae more robust, making the spines less conspicuous. Tarsal claws as in female, but the teeth relatively longer, more slender and conspicuous. (Described from the single individual taken.)

Altho this species belongs in Eutychides rather than in any other described genus, there are certain characters which may be considered by some as sufficient basis for a new genus; but I think it best to leave the matter as herein considered, at least until opportunity is had to examine the Mexican species of the genus.

The burrow of this species is long and narrow, with usually one of two types of a lateral branch, and a thin "wafer" trapdoor at the surface. In adobe soil, or compact sand, the branch is generally below the upper third of the burrow and is a very neat lateral chamber, about three centimeters long (with adult spiders) 10 to 12 mm. diameter within, with a circular sharp-edged opening (5 to 8 mm. diameter) into the main tube, which is enlarged at this place. In soft loamy soil in wooded canons and along streams, the branch is usually near the surface, is of less definite size and shape, and joins the main tube by a larger, less regular opening, the whole branch having the appearance of being the old abandoned upper end of the nest. Such it may be, but it evidently serves the purpose of the lateral chamber, for in no case have I found below the neater, more horizontal chamber. In only one case have I found the spider in the chamber. It is not closed by a trap door. The burrow is well lined thruout with an opaque-white sheet of silk, a whiteness which I have learned to recognize as belonging to this species, in comparison with the other trapdoor species found here. On wooded hillsides and along thicketed banks, where the species is apt to be most abundant, and where much dead grass, fallen leaves, and other vegetable debris occurs, the silken tube is frequently extended up thru the loose mass for from one to eight centimeters, supported and decorated on the outside by whatever may be near, weed-stems, dead grass, loose soil, moss, leaves, etc., but always the

entrance closed by the trapdoor, except for which a few could be easily mistaken for "turrets" of Atypoides. In these above-ground extensions the rim is usually a little inflated, funnel-like, the door resting more-or-less loosely upon the rim. In such cases the door is commonly a small leaf, or leaf-portion, with just enough silk to hinge it in position and form a lace-work on the under side, in which the spider can fasten its claws. In open situtions, the trap is generally level with the soil surface, in level or somewhat slanting spots, and is composed of a thick lining of silk below with a complete layer of soil above, more-or-less decorated with moss or leaf-bits, always assimilating its surroundings. One of the largest burrows examined was 27 cm. deep, 14 to 18 mm. diameter, with trapdoor 14 x 12 mm.; lateral chamber only 6 cm. down, with 7 mm. opening and 13 mm. greatest diameter. Another was 28 cm. deep, 15 to 18 mm. diameter; trapdoor 25 x 16 mm. (unusually large); lateral chamber 18 cm. down with 9 mm. opening and 3.5 cm. long. The one male found was in a typical burrow, with typical trapdoor, lateral chamber, and silk lining.

No knowledge was gained concerning their feeding habits, except that near dusk the spiders are found out at the surface, with the trap raised just a little, enough for the hidden animal to see out, evidently watching for a chance to grab some passing insect. If the door is touched, the spider may jump out at the stick, or other object, extended, and then hurriedly retreat into the depths of the nest; again it may fasten its claws in the silk lining of the trap and hold the door down firmly. If the door is forced open, it will hastily retreat to the bottom of the tube.

The eggs must be laid sometime in the summer, as females with the abdomen much enlarged and the egg-filled ovaries showing thru the ventral skin have been taken in March and June. Females with young running about in the nest were taken in September, October, and December.

Young taken from the nest of the parent and placed in individual vials, with an inch of loose moist soil, burrowed into the soil, within a few hours, with few exceptions, and placed neat little traps (measuring about 5 x 4 mm.) at the proper place. At various times certain of the doors were removed, new ones being usually built within a few hours. One which neglected putting a door to its burrow, finally did so, after being disturbed with water, two months later. In general, they were sadly neglected as to being supplied with food; but once, upon removing some of

the traps, certain ones came out at once, as if to learn the cause of the disturbance. A live mosquito, presented by forceps to one little spider, was savagely seized and carried into its tube. An injured house-fly, placed near the burrow of another young spider (5 mm. long, or less), was vainly tugged and pulled at for some time. When noticed at the surface, with the trap raised just a little and disturbed, they would commonly hold the door down as do the adults.

Not a few specimens were found to have a colony of minute mites on the anterior slope of the abdomen above; the whole colony, of thirty or more, measuring little more than a millimeter across. Minute Collembolae are commonly found running about in the nests.

Aptostichus Simon. Actes Soc. Linn. Bord., 1892, p. 317.

This genus, with its two described species, was made known by Simon in his "Liste des Especes de la Famille des Avicullariides qui habitent l'Amerique du Nord." I find no record of the genus having been collected or studied since; but Simon, in his Histoire Naturelle (II, Supp., p. 901), adds a few male characters not mentioned in the original diagnosis. The two species, as given, are:

A. atomarius ..... California (Morrison)
A clathratus . . California: Sta. Rosa del California (Geo. Marx).

I have collected, and have before me, two species which I believe belong to this genus, and, indeed, seemingly differ from it only in the character of the sternal impressions, which in one species are of the type described for Eucteniza and Cyrtauchenius, in the other nearer Amblyocarenum, not at all as in Stenoterommata, as illustrated in the Histoire Naturelle (I, p. 102). As in Eutychides versicolor, the smaller the individual, the relatively smaller, less pronounced, and farther apart are the sternal impressions, both posterior and medial,—at least such is the case in the new species described below. Still, altho Simon's type specimens were presumably comparatively young individuals (14 and 15 mm. long, respectively), I find in my specimens of the same size, and smaller, no excuse for interpreting the sternal impressions as being of the Stenoterommatan type, ascribed to Aptostichus. The type of A. clathratus is in the U. S. National Museum, at Washington, and Mr. Nathan Banks has recently examined the specimen, at my request. He writes, "The sternum shows no

impressions, on each posterior side is a faint depression, but no true impressions, * * * " Mr. Banks also informs me that it is from Santa Rosa Island (near Santa Barbara), not Santa Rosa, Sonoma County. The type of A. atomarious is, unfortunately for me, in France, and the specific type locality not recorded. Until I have collected in many other portions of California, and satisfied myself that a genus exists, in this State, having the sternal impressions, and other characters, ascribed to Aptostichus, I do not feel justified in proposing a new genus to include my material now assigned to that genus.

Aptostichus atomarius Simon. loc. cit.

I have two specimens, large females 25 and 27 mm. long, respectively, taken along the Sur County-road, near Carmel, south of Monterey, December, 1907. These show some variations from the description of A. atomarius, but agree with that form too well, in what seem to me to be the more reliable specific characters, for me to try to establish a new species upon this limited material. A sufficient series, however, including many ages and sizes, may lead to other conclusions later on. I searched several hours for additional specimens, on the day these two were found, and returned several days later, going over the same and adjacent ground, but all in vain.

Plate XIII, fig. 32, shows the sternal and labial characters as represented in these two individuals, excepting that, in the one drawn, the labium has three spinules, while in the other it is unarmed. The anterior two of the six impressions are quite distinct. The eye-tuber is much higher than in the next species, is very prominent (Plate XIV, figs. 30 and 31), but is not mentioned by Simon. The abdominal markings are of the pattern shown in Plate XIII, fig. 27. The pale appressed pubescence of the cephalothorax, as well as the shape, thoracic-pit, etc., is well shown in Plate XVI, fig. 3, and needs no lens for its discovery. The armature of the pedipalps and legs show some interesting variations: Tarsi P with two sub-basal spines, one individual having also a small sub-apical spine, externally; tibiae P with three apical spines, each lacking one of the four other spines to be expected, the missing spines not corresponding as to position. Tarsi I and II unarmed, considerably shorter than metatarsi; metatarsi I with one to three small apical spines and one to three other short stout spines, not constant in position;

metatarsi II with two or three apical spines and three or four others on the basal half, varying as to position. Patella III with a more or less triangular patch of from 10 to 18 stout spines, as in the next species. Tarsi IV unarmed in one specimen, in the other, each with four spines.

The specimens were taken from their nests, which were in sandy banks along furrows cut in the hillside during heavy rains. The burrows were short, but of large diameter, measuring only 13 and 15 cm. long respectively, and varying from 18 to 25 mm. in diameter; much enlarged externally, but the silk tube itself contracting somewhat, the space thus left between the heavy silk tube and the solid soil being filled with loosely mixed sand and silk, this mass being readily pulled out with the trapdoor, etc. In one case the surrounding soil had washed away considerably, leaving the mass of silk and sand protruding some 15 mm. from the bank. Near the center of the external surface of this mass, which had a more or less laminated appearance, was the rather thick trapdoor, of sand and silk, measuring about 20 x 15 mm.

Aptostichus stanfordianus sp. nov.

(Plate XIII, figs. 20–31; XIV, figs. 17–29; XVI, figs. 4–5.)

Adult ♀ (Plate XVI, figs. 4–5)—Measurements from my largest specimen, No. 137: length 21 mm.; cephlx. 9 mm. long, 7.5 mm. wide; abdomen 11 mm. long. Cephalothorax tawny, slightly or decidedly olive-tinted, darker along furrows bounding caput; apparently glabrous, the scattered pale tawny minute hairs noticeable only under a good lens; posterior margin nearly straight or somewhat emarginate; a row of pale colored cephalad-bent setae along median line of caput; caput medium in convexity, the caudal-converging sides forming nearly straight lines (Plate XIII ,figs. 25 and 28); eye-tuber nearly black, about half as high as long (Plate XIV, figs. 22–24); eyes as in Amblyocarenium, variable (Plate XIV, figs. 19–21) A. E. blue-gray, P. L. yellowish-white, P. M. opaque-white, conspicuously luminous. Chelicerae darker than cephalothorax, with alternating glabrous and setose areas above, the setose lines fusing near the apex, apex merely rounded; rake of many teeth (Plate XIII, figs. 20–21), extending well up the inner edge above; fang smooth and rounded on inner edge. Abdomen oblong to elliptic; yellowish-brown, marked above with a median series of dark brown blotches, larger cephalad, and lateral series of cephalad-converging short linear spots, with various less definite spottings in between—the basis of these spots being rings of pigment, distinct in the lightly-marked specimens, but confluent and more-or-less obsolete, as rings, in the heavily-pigmented individuals (Plate XIII, figs. 26–27). Spinnerets four, the superior pair as shown in the last mentioned figures. Sternum tawny, decidedly olivaceous in the darker specimens, black-setose; six impressions, the anterior pair not apparent in many individuals, but readily seen in sterni dissected out and mounted in balsam, posterior pair medium in size, elongate elliptical to nearly round, almost as close to each other as to the margin (in adults) or much nearer the margin than to each other (in young individuals) (Plate XIII, figs. 29–31), darker in color than the rest of the sternum, probably because of thicker walls to the epithelial cells at these spots, as seen under the compound microscope. Labium wider than long, emarginate in front, with three to ten spinules, in a well defined transverse row or scattered (Plate XIII, figs. 22–24). Coxae

of pedipalps with many spinules cephalo-mesad below (Plate XIV, fig. 17); tarsi P densely scopulate below, with two sub-apical and two sub-basal spines (97%); next joint with four sub-apical spines (the middle two often quite slender) and two laterals on each side (83%) (Plate XIV, fig. 29 P), also setose. Legs tawny, more or less olivaceous mesad; tarsi I and II unarmed, not setose, metatarsi I not setose, but with two apical spines and two laterals near outer margin, one near inner margin (88%), metatarsi II slightly setose, with three apical spines and two laterals on each margin (79%) (variations from the formulae here adopted as typical are mostly due to the addition of one or more spines, usually slender ones not affecting the arrangement or presence of the spines of the typical system) (Plate XIV, fig. 29 "I" and "II"); patellae III with a patch of distinct spines, ten to fifteen, or more, usually with two curved rows below and the remainder scattered above, commonly not constant in number on opposite sides of an individual (Plate XIV, fig. 18); femora IV with a dense bunch of black setae at the outer apical edge, but not spinose as in Eutychides versicolor; tarsi IV commonly spined, but without constant formula, occasionally unarmed; legs otherwise as in other species of Aptostichus. Tarsal claws with two or three large inner basal teeth, more or less continuous with the basal end of the outer row of small teeth (Plate II, figs. 25–28). I can see no real difference between the anterior and posterior claws as to the teeth.

The above description is based upon a series of twenty-five individuals, ranging from 10 to 21 mm. length, the percentages given above, however, taken from tabulations made when but twenty-one were at hand. My No. 102 is taken as the type specimen, and deposited in the Entomological Museum of Stanford University. It was taken on the Stanford Estate, near the University. The rest of my material was taken in the foothills in this vicinity, in the ravines of the mountains west (not above 400 feet elevation, however), at Oceanview, San Francisco Co., and in the gullies of the pine forest on the Monterey Peninsula, it being the only trapdoor spider I have yet found there. Also a cast skin was taken from an abandoned burrow near Alum Rock, east of San Jose. It is the least common trapdoor species about Stanford, but abundant in its limited range near Pacific Grove. I have not yet secured a male.

The range of variation in intensity of color is correlated with the light relations of the environment and cannot be considered as of specific value. I have studied carefully the series before me, and while considerable variation exists between various extremes, selected with respect to certain variable characters (such as color, eye relations, thoracic pit, labial spinules, sternal impressions, etc.), I can find no definite set of differences constant enough to warrant specific separation of any two types amongst this material. Those situated in the open average much lighter in color, while those from the shades of the forested ravines are darkest in pigmentation. This species appears to be closer to A. clathratus than to A. atomarius.

The burrow is much shorter than in Eutychides versicolor and relatively of greater diameter, in proportion to the size of the spider. The silk lining is thicker and whiter than in the other genus. Three specimens had branches of the surface type, not true lateral chambers. Above-ground extensions are common, especially at Pacific Grove, and the variations described for E. versicolor might be repeated here, it being practically impossible to distinguish between the "turrets" and traps of the two species, as to appearance and variable structure. The proportions of the burrow and the thickness of the silk tube are to me the only clue to the identity of the genus before the occupant is reached. The largest burrow, that of No. 137, gave the following dimensions: length, 20 cm.; average diameter, 15 mm.; trapdoor, 22 x 17 mm., of soil, moss and grass-bits, and a small leaf. Some of the burrows are surprisingly short, being only 10, or even 6, cm. long.

Number 137 was taken Oct. 31, 1907, and had some sixteen or more young, about 5 mm. long, running about in the deeper end of the tube. Fourteen of these were brought into the laboratory and placed in vials. Most of these burrowed into the soil at once and made little trapdoors about 3 to 4 mm. wide. They were not properly cared for, but, almost two months after being brought in, they replaced their doors when same were removed.

It may be noted here that these young, direct from the mother's burrow, both in this species and in E. versicolor, are readily referable to their respective genera by the characters of the cephalothorax and the abdominal markings; while the sternum, pedipalps and legs give no clue to the genus to which the specimen belongs. This is significant, if the characters earliest established in ontogeny are of most importance in classification.

Eurypelma californica Auss. Verh. zool.-bot. Gessell. Wien., 1871, p. 214.

(Plate XVII.)

The genus Eurypelma is found in California at least as far north as San Mateo County, in the outer Coast Ranges. It used to be common about Stanford University, a few specimens being deposited in the entomological collections here, but it seems to be rare or local about here now. One or two are picked up and brought in almost every year, two large ones having been taken this year—one, a male, picked up while crossing a road (October), the other, a female, found under a rock on the top of one of the

foothills behind the University (March). Many a days' search thru the lowlands and over the foothills, during the last ten months, had left me without finding a single specimen. Just recently, however, my friend, Wm. F. Derby, discovered two local colonies on Jasper Ridge, amongst the foothills, some three miles west of the University, and brought in a live female to prove his find. Returning to one of these colonies together, we secured several specimens, all females, and noted carefully the nesting habits.

I have before me one male from Ventura Co., three from San Diego (San Jacinto), three from Santa Clara Co., and one from Madera Co. (North Fork), also several females, including fifteen from the Jasper Ridge colonies, none of the females having been studied to any extent, however. In addition to these is an interesting series of seven small males and two females from Fort Wingate, N. Mex., kindly loaned me by Mr. Karl Coolidge, of Palo Alto.

Eight species of Eurypelma have been ascribed to the United States (including Lower California), four of which have been described from the male alone, two from the female alone, only two having both male and female described. Five of these species are attributed to California, only one of which has both sexes described, two known only from the male, two only from the female. Simon, in his "Liste des Especes * * * etc.," gives a key to the males of five species, omiting E. liogaster because the diagnosis given yields no characters not common to all the others he recognizes, and of course E. californica and E. rileyi, the males of which have not been described.

A careful study of my material, with reference to the characters selected by Simon as of greatest importance, does not permit me to determine satisfactorily the species that should be represented in the series, and I prefer to group the Californian specimens under the oldest name, E. californica, until I have opportunity to collect and examine a much larger series, from many localities.

This is the well-known, large hairy tarantula of the South-west. It is popularly known to dig in the ground, altho, according to Simon, few of the Aviculariinae make a true excavation. I find in an old number of Science (1884, III, 62, "Notes and News," p. 467) an interesting note which I will quote, in part. Speaking of Cteniza californica, it says: * * * "its trapdoor nest is usually

placed in museums beside the tarantula (Mygale hentzi), and erroneously labeled as the tarantula's nest. This popular error **** is stranger, since the tarantula is usually too large to enter the nest of Cteniza, and **itself makes no nest,** occupying crevices in the ground or under stones, spinning a small web." Perhaps another record of this "popular error" is in Ausserer's remark, after his description of E. steindachneri (Verh. z.-b. G. Wien, 1875, p. 200), which says: "**** das Nest, an dessen Grunde das Thier in der Regel sizt, ist circa ein Schuh tief, hat kaum ein Zoll im Durchmesser, und der Deckel passt so genau, dass er mur mit grösster Mühe vom Boden unterschieden werden kann." What Ausserer means by "Deckel" is fully explained on page 128 of his paper, where Eurypelma steindachneri and Cteniza californica are cited, with some other species, as examples of the spiders building a "Korkdeckelnest (Cork-covered nest)."

I am not now ready to believe that any of our Eurypelmas make a trapdoor of any kind. The loose webbing, common at the entrance of the many burrows observed in the Jasper Ridge colonies, is hardly less conspicuous than the open hole. The site of each of these colonies is adobe soil, with much outcroping of rock fragments, in open, grassy spots on the hill-sides. There is no evidence that these spots have ever been cultivated.

The burrows were mostly alongside of rocks, commonly bending under the rock if it was a small fragment; a few burrows were one or two feet distant from the nearest rock. The entrances are sometimes nearly circular, but usually quite irregular in shape, and were more commonly loosely "spun up" than open. The burrows are from 20 to 40 cm. long, very irregular in diameter and form, and exhibited little or no web-lining except near the entrance. They are undoubtedly dug by the spiders. No males were found.

When disturbed and placed out on the ground, these spiders hold the abdomen up, waving the long spinnerets about. Their movements are very sluggish and little fight is shown when disturbed. The elevating of the abdomen may be intended to frighten away the intruder; but as a fine mesh of silk is spun from the active spinnerets as the spider slowly walks along, the real purpose of the action may be to ensnare or discommode an attacking "tarantula wasp" (Pepsis), their worst enemy. Upon continued interference, the abdomen is lowered, the fourth pair of legs raised and their metatarsi rubbed against the posterior portion of the

abdomen above. This peculiar action may be largely responsible for the bare spot on the rear of the abdomen in many specimens. None of the series secured upon Jasper Ridge was so denuded, but several individuals, both male and female, in the other material of the collection here, have such a bare space above the spinnerets. One large male, brought into the laboratory early in the Autumn and kept alive for several months, had a conspicuous bare spot and would rub this spot with its metatarsi IV when disturbed from behind. If worried from in front, however, the first pair of legs would be raised, the whole body slowly swung backwards, followed by a quick spring forward, scarcely over two centimeters, however, bringing down the front legs with considerable force.

Altho I have made no particular study of the matter, as yet, I do not believe that the bare spot on the abdomen has any value as a specific, or other taxonomic, character. While the color characters are quite constant in my Jasper Ridge series, considerable variation exists in the New Mexican series mentioned above.

The first specimen brought in by Mr. Derby was secured by pouring water down the burrow. That these tarantulas come out readily when water is poured into their holes, is a well-known fact in California, and many a small boy and camper finds amusement in the performance, as also in putting two individuals together and having a "tarantula fight."

Brachythele longitarsis Simon (♂) Ann. Soc. ent. Fr., 1891, p.305; (♀) Actes Soc. Linn. Bord., 1891, p. 319.

(Plate XVIII, figs. 1–2; XIX, fig. 1).

Reported from California, Idaho, and Texas, this form seems to have a wide distribution. It is abundant about Stanford University, San Jose, etc., and seems to hold its own in fields and orchards plowed annually. It is common alike in the valley levels and on open hillsides all thru the hills, at least up to 1600 feet and undoubtedly higher. I secured it in Sonoma County, between Guerneville and Forestville, and in Monterey County, near Carmel. Specimens are in the collection here from San Diego County.

Both sexes of this species are described from immature specimens (i. e., ♀ 19 mm. long, ♂ 15 mm. long), and the original descriptions do not do justice to some of the important adult characters. However, it is evident that Simon has more recently

received larger specimens, and has added (Hist. Nat. des Araign., II, Supp., 1903, p. 964), a few points of great help to one working with mature individuals of either sex. I have before me about fifty specimens, including six males. At least half of the females measure over 30 mm. in length, one of the largest measuring 46 mm. long, cephlx. 17 x 14 mm., abdomen 21 mm. long. The scopula is very thin in half-grown, and smaller, specimens, but very dense in the mature individuals. On tarsi I and II it is uninterrupted, on tarsi III it may or may not be longitudinally bisected by a more-or-less distinct setose line, while tarsi IV have a very prominent row of black setae bisecting the scopula, comparable to that illustrated as characteristic of Ischnocolus and its relatives, but said to be present in Brachythele subcalpetana (loc. cit., I, 1892, p. 180), tho nowhere mentioned in connection with B. longitarsis. Simon has added (loc. cit., II, p. 965) that the density of the scopula varies according to the species, and in the larger (B. longitarsis) it forms under the claws, tufts comparable to the fascicles of the Avicularíinae. This is quite true, and the third claw, readily seen in young specimens, is so well concealed amidst these tufts that only careful dissection will reveal it. It is easily scraped off in trying to scrape away the surrounding hairs. In the male of this species, tibiae I are provided with the obtuse tubercle bearing two unequal, closely contiguous spines. This is also true of a specimen loaned me by Mr. W. F. Allen, of Pacific Grove, the spider coming from a bunch of bananas, shipped in, presumably, from the west coast of Central America. It is evidently of another species, but was not determined beyond the genus.

Our Brachythele does not spin a large flat web, after the manner of the Agelenids, as do the Diplurinae, in general, according to Simon. On the contrary, it digs a deep burrow in the soil, lining only the upper fourth, or less, of the tunnnel with considerable or very little web. Occasionally, however, more or less of a web is spread without the cavity, if the site selected is in very loose soil or in long grass; but usually there is little or no suggestion of an outside web, at least within the limits of my experience. Frequently the mouth of the burrow is "spun up," or closed, with silk, compactly at the surface (Plate XX, fig. 1), or loosely and down for some 5 or 6 cm.; my only explanation for this habit being that the spider has had a full meal and wishes to rest undisturbed. It seems to have no peculiar connection

to moulting or breeding time, as I supposed at first. The burrows enlarge considerably below the upper half, and commonly become nearly horizontal below, with rough, irregular, usually unlined walls, except at egg-laying times,—nests with cocoons usually being well-lined. The "cocoon" is fastened to the roof of the cavern. Egg-laying is probably in early summer, but I have no exact data yet as to the month. Numerous cocoons, found in September and October, contained the exuviae of the young's first moult; but the young were gone in all cases. Over fifty of these exuviae were counted from one cocoon. Cast skins of the adults are commonly found in both occupied and deserted burrows, in the Autumn.

Mating time is in the Autumn, when the males may frequently be found walking about on the surface of the ground. Oct. 30th, a pair were taken from one burrow. The female was met with several centimeters up the tunnel, she being more aggressive than usual. The male was down below, and, unlooked for and unexpected, was injured in one palpus and one leg as I was roughly following the long burrow to its end; but the two were brought alive into the laboratory and put into a spacious cage together. The next day the male was found partially wrapped in silk, with the female standing over his remains, still feeding. Later she dug something of a cavity in the soil of the cage and lined the entrance and vicinity with considerable silk. One male was found alone in a well constructed, rather long burrow. It may not have dug the cavity itself, however, as it may have merely appropriated an abandoned one. Males have been found under rocks and planks.

Brachythele is common on Jasper Ridge, mentioned above in connection with Eurypelma. Mr. Derby and myself being surprised to find a Brachythele at the bottom of a few of the burrows amidst the colony of Eurypelma. Similar soil, etc., only a stone's throw away, contained many Brachytheles, but no Eurypelmas. Hence we had a good chance to compare the nesting habits of the two very different species. In fact, we looked in vain for some external evidence sufficient to identify with certainty the genus of the occupant of the burrow. Altho the burrows of Brachythele undoubtedly average more in length and are not so apt to be close to rocks, so much variation exists as to the depth, various diameters, shape, directions, web-lining, proximity to rocks, etc., that we found it impossible really to know

which species we were digging out until the inmate itself was reached.

When disturbed, Brachythele takes a most spirited attitude of defense and usually grabs quickly and savagely at whatever is thrust toward it. If its fangs can penetrate the object introduced, it holds on tenaciously; but if the object is a hard stick or glass rod and resists the insertion of the fangs, the spider hesitates a moment, then hastily retreats into the darkest corner available. Upon further disturbance, and brought to bay, the animal flops over on its back, and with legs and chelicerae spread, fangs fully extended and often dripping with liquid, awaits an opportunity to get in effective work on its tormentor.

Specimens in captivity go eagerly for water when it is provided after considerable neglect. They spread their chelicerae in sucking up the fluid. They capture and devour individuals of their own kind, as well as others, put in with them. One large female caught and ate a small lizard, of the genus Gerrhonotus, of some twelve centimeters length. Carabid beetles are favorite food and their eletra are commonly found in the burrows out in the field. A large tenebrionid, Eleodes, was placed in a cage with several tarantulas, at different times; but not only does the spider fail to attack the beetle, but it will either walk away from it or permit itself to be literally walked all over by the tenebrionid. This same beetle spent some two months in a cage with a large male of Eurypelma, and is still alive; while a small Scelophorus lizard spent but two or three days in the cage before meeting the fate of its cousin Gerrhonotus.

Brachythele also suffers considerably, in nature, from the attacks of the tarantula hawks, Pepsis.

Atypoides riversi Cambr. Proc. Zool. Soc. Lond., 1883, p. 354.

This species has been well described by Rev. O. P. Cambridge. It has been reported from Berkeley, from Santa Clara Co., and from the San Bernardino Mountains. I find it abundant along shaded streams and in thickets in the foothills and mountains wherever I have been, on both sides of the Santa Clara Valley, between Guerneville and Forestville in Sonoma Co., and in the pine forest of the Monterey Peninsula. It is probably to be found thruout the Coast Ranges of California, in all forested areas, if not also in the Sierras. I have seen no males, but have no reason to question the description and drawings of Cambridge.

The "turrets" are open, no door closing the entrance. Sometimes the edges of the chimney are drawn together with numerous strands of silk, effectually closing the entrance, this being done, apparently, at the pleasure or need of the individual, as in Brachythele, and not being a seasonal habit of the species. The burrow is long and well lined with a white silk tube of about the thickness and whiteness of that of Eutychides versicolor. The tunnels are commonly considerably reduced in diameter for the last two centimeters, making a snug fit for the spider, and here it usually snuggles down tightly when the digging has reached the limit necessary to secure the specimen. Hard soil seems to be preferred by this spider, either sandy or adobe. Tho the upper portion of the nest may be thru loose vegetable mould, the lower portion is sure to be in compact soil. The turret may be supported by grass, etc., or standing alone; it is made of silk within and of soil without, decorated or not with whatever is close at hand, whether as a matter of chance or purpose, a matter of convenience or protective coloration, of adornment or contributing to the strength of the structure, it is not easy to decide. A neat type is one well decorated with moss and leaves, small twigs, etc., and with a pale green rim of bits of the common drooping tree-lichen, Ramelina (Plate XX, fig. 4); another is one with pine-needles fastened all over the exterior, the needles pointing in all directions (Plate XX, fig. 3), common at Pacific Grove.

Several of these spiders were brought into the laboratory and they readily constructed burrows and turrets in normal manner, even using loose moss that was placed near the turrets several days after the completion of the nests.

Young, taken from the nests of the parents, very soon dug each its own burrow and built its chimney, whether put with the mother in one large battery jar, or alone in individual vials. It was very interesting to find them up at the mouths of their tubes, waiting for food material to come along. This was at first only about dusk, but later on was at any time on dark days. Small ants, placed in the jars or vials, were caught and carried into the lower regions of the burrows. Small green aphids were, by one brood especially, eagerly taken from the forceps and carried to their fate. The young spiders would jump out after a passing ant or aphis as far as they could reach, always holding on to the rim of the turret with the claws of the fourth pair of legs. They commonly missed their pray, however, jumping too soon or too

late and often when the insect was considerably out of their reach. A hasty retreat into the tube always followed these efforts to secure a meal.

Aliatypus gen. nov.

As already stated, the finding of the male of Atypoides californica Banks has shown that the species can no longer be referred to that genus; nor can it, in truth, be placed in any other genus now described. Tho the female is quite similar to that of Atypoides riversi, the males of the two species are so different in notable structures that generic separation of the two is quite necessary. The new genus may be known by the following characters:

Cephalothorax rather flat caudad, broader than in Atypoides; thoracic pit short, round; caput lower and more rounded at the summit; eyes about the same, situated on the nearly perpendicular slope of the anterior edge, eye-tuber nearly obsolete except portion bearing anterior median eyes, which is more pronounced in the male; chelicerae in female gibbous at the base above (Plate XV, fig. 6), lower and more rounded than in Atypoides (fig. 7), in male not gibbous basally (fig. 2), and without curved projecting apophysis of Atypoides (fig. 8); abdomen shorter, more rounded, with a sub-triangular glossy spot on the anterior slope above, this spot somewhat fine-setose and with a transverse row of much larger setae, normally four in number, on its posterior edge (glabrous in Atypoides), post-abdomen well above spinnerets, which are much stouter, with shorter thicker joints, the outer inferiors nearly as large as the inner; sternum much larger, with six impressions, the anterior pair often so close to the margin as to be hidden by coxae I; labium much wider than long (figs. 1 and 5); coxae of pedipalps, in male, with a short lobe at the cephalo-distal corner (fig. 1), almost as in Hexura (Simon: Hist. Nat. des Ar., II, p. 971, fig. IIII), coxae P in female hardly different from same sex of Atypoides, pedipalps of male (fig. 3) as long as legs I, relatively twice as long as in Atypoides (fig. 9), bulb with long slender conductor; legs robust, many spined.

The generic name is derived from alius and Atypus, signifying "a different Atypus."

It is interesting to note that the pronounced gibbosity at the base of the chelicerae above in the female of Atypoides (fig. 7), is in the male exaggerated into a long, curved projection (fig. 8); while the homologous, but less pronounced, gibbosity of the female of Aliatypus (fig. 6) is almost obsolete in the male of that

genus (fig. 2). In the length of the pedipalps, the male of Atypoides is of the more common type; while Aliatypus is conspicuous for the great elongation of certain segments of those organs (cf. figs. 3 and 9).

Aliatypus californicus, Banks. (Atypoides). Jour. N. Y. Ent. Soc., IV, 1896, p. 88.

(Plate XV, figs. 1–6; XIX, figs. 3–4).

Adult ♂ (Plate XIX, fig. 3)—Length 12 mm., cephlx. 5 x 4 mm., abdomen, about 5 mm. long. Cephalothorax shiny, glabrous, excepting the margins which are minutely black-setose, coarser than in female, pale yellow, paler than in female, the median line and borders of the caput olive-tinted; anterior eyes closer together and eye-tuber a little more projecting than in female; chelicerae very slender, not gibbose at the base as in female, but the inner edge swollen into a rounded setose ridge anteriorly; abdomen grayish, finely black-setose and with scattered much larger black setae, fewer and more scattered than in female; sternum glossy flesh-color, darker and yellow in female; pedipalps as long as legs I, coxae with small lobe, trochanters twice as long as wide, femora and patellae reddish, femora very long and slender, longer than femora I, nearly straight, conspicuously black-setose below on the apical half, patellae long, club-shaped, long-setose below on apical half, tibiae the same, but longer and gibbous below near the apex (Pl. XV, fig. 3), tarsi of generalized type, bulb (fig. 4) very angular, black basally, opaque glossy white below, the broad, flat, angular spine reddish, a very slender, blackish conductor extending out along edge of spine, almost to its suddenly contracted tip; legs more slender than in female, coxae and femora pale flesh-color below, trochanters and rest of leg-segments yellowish, tarsi and metatarsi conspicuously long and slender. (Described from my Nos. 98 and 100).

I will not add further to Banks' description of the female. I have collected some fifty individuals, the largest measuring 23 mm. long.

I have not yet found this spider outside of the foothills and mountains on each side of the Santa Clara Valley, Santa Clara and San Mateo Counties, but it is probably not at all limited to such a small range. Mr. R. W. Doane secured the type material on Black Mountain, Monto Bello Ridge, of the Santa Cruz Ranges. It is common at Alum Rock Park and in the Mt. Hamilton Range at least up to 2900 feet elevation. It is a trapdoor species and seems to have a decided preference for fine compact sandy soil, especially where exposed along streams, roadside banks, etc. Where found it is usually very common. Occasionally it is found in sandy adobe. It is commonly associated with Eutychides and Atypoides.

The burrow is comparatively long, simple, with simple trapdoor. I have seen no evidences of branches of any type, nor any suggestions of extensions above the surface. The silk lining is so meagre as to be practically indiscernible. The banks usually have little or no vegetation upon them other than short scattered moss, and the traps usually are of soil and silk only, or with a few

bits of moss or grass on the outside. Burrows found in dry exposed banks, from September until the first rains in December, had the traps plastered down firmly with soil. A few along flowing streams in the shaded redwood ravines were not so closed, tho in a roadside bank, only a few rods up the canon side, all the nests were plastered up. At the bottom of a nest, so closed, was always a spider, in more or less dormant condition. Doors sealed up in this way are harder to see, as a rule, than when normally fastened at the hinge only. Many of the burrows were found by mere accident, as it were, in digging promiscuously, or following out the burrow of something else. The burrows of small specimens are not easy to distinguish from those of certain mining bees, tiger beetles, etc., if the trap is left out of the comparison. None was found with sealed doors from the end of December to the end of April. No observations were made during May, but all nests found during June had the traps firmly plastered down as in September and October. Undoubtedly this hibernating period is coincident with the dry season of the Californian coast. The dimensions of two of the largest nests examined are: No. 199 trap 21 x 15 mm.; burrow 16 cm. long, nearly straight, outer half 15 mm. diam., inner half 20 mm. No. 203, trap 18 x 13 mm.; burrow 25 cm. long, 18 mm. diameter, with two decided bends.

CONCLUSIONS.

It is evident that the knowledge of our West Coast Araneae theraphosae is far from perfect, and much interesting work is yet to be done. The taxonomic work is yet none too satisfactory and many gaps in the life histories are waiting to be filled in. Questions in distribution must be many and extensive, as only two forms are reported from Washington and Oregon, with one record between there and Mariposa County, California. Nevada seems to have not a single record, and Idaho has but two. Even in the South-eastern States the situation seems to merit considerable attention, and in the South-west the genus Eurypelma is a study in itself. While there are probably many taxonomic questions awaiting the attention of students, it is very apparent that conclusions reached in the laboratory should be based upon as large series as possible and accompanied by extensive field observations; for I find, in certain of the species discussed above, variations comparable to specific differences claimed by some authors.

My acknowledgments are due to Prof. V. L. Kellogg and Mr. R. W. Doane for valuable suggestions and criticisms thruout the year of study; also to Dr. C. H. Gilbert and Dr. M. I. McCracken;

to Profs. Comstock and MacGillivray, of Cornell, for copies of numerous descriptions; to the Cornell University and the Congressional Libraries for the loan of certain books; to Mr. Nathan Banks, for service already credited to him; and to many other friends in and out of the University, who have aided me in various ways.

The photographs presented herewith were taken by Mr. R. W. Doane, mostly from preserved material. The drawings are original, with the exception of figs. 8 and 9 of Plate XV, which two are copied from Cambridge.

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EXPLANATION OF PLATE XIII.

Eutychides versicolor ♀ (Figs. 1–18), ♂ (Fig. 19)

Fig. 1—Sternum and labium, No. 195.
Fig. 2—Sternum and labium, No. 234.
Fig. 3—Sternum and labium, No. 60.
Fig. 4—Sternum and labium, No. 162.
Fig. 5—Sternum and labium, No. 200.
Fig. 6—Sternum and labium, No. 193.
Fig. 7—Cephalothorax, lateral aspect, No. 234.
Fig. 8—Cephalothorax, lateral aspect, No. 128.
Fig. 9—Dorsal abdominal markings, heavy, No. 195.
Fig. 10—Dorsal abdominal markings, light, No. 234.
Fig. 11—Cephlx. and chelicerae, dorsal aspect, No. 123.
Fig. 12—Cephlx. and chelicerae, dorsal aspect, No. 60.
Fig. 13—Labium, No. 164.
Fig. 14—Labium, No. 163.
Fig. 15—Fang and rake of chelicerae, from below, No. 273.
Fig. 16—Fang and rake of chelicerae, from within, No. 273.
Fig. 17—Fang and rake of chelicerae, from below, No. 128.
Fig. 18—Fang and rake of chelicerae, from within, No. 128.
Fig. 19—Genital bulb left, two views, No. 269.

Aptostichus stanfordianus ♀ (Figs. 20–31.)

Fig. 20—Fang and rake of chelicerae, from within, No. 120.
Fig. 21—Fang and rake of chelicerae, from below, No. 181.
Fig. 22—Labium, No. 179.
Fig. 23—Labium, No. 120.
Fig. 24—Labium, No. 137.
Fig. 25—Cephlx. and chelicerae, dorsal aspect, No. 213.
Fig. 26—Dorsal abdominal markings, heavy, No. 213.
Fig. 27—Dorsal abdominal markings, light, No. 102.
Fig. 28—Cephalothorax, lateral aspect, No. 213.
Fig. 29—Sternum and labium, No. 213.
Fig. 30—Sternum and labium, No. 266.
Fig. 31—Sternum and labium, No. 177.

Aptostichus atomarious ♀ (Fig. 32).

Fig. 32—Sternum and labium, No. 209.

EXPLANATION OF PLATE XIV.

Eutychides versicolor ♀ (Figs. 1–16).

Fig. 1—Tarsal claws, leg IV, inner faces, No. 110.
Fig. 2—Tarsal claws, leg I, outer faces, No. 110.
Fig. 3—Tarsal claws, leg II, inner faces, No. 60.
Fig. 4—Tarsal claws, leg IV, inner faces, No. 60.
Fig. 5—Eye tuber, lateral aspect, No. 195.
Fig. 6—Eye tuber, lateral aspect, No. 128.
Fig. 7—Eye tuber, lateral aspect, No. 234.
Fig. 8—Eye tuber, caudal aspect, No. 128.
Fig. 9—Eyes (anterior row above), No. 200.
Fig. 10—Eyes (anterior row above), No. 229.
Fig. 11—Eyes(anterior row above), No. 151.
Fig. 12—Eyes (anterior row above), No. 234.
Fig. 13—Eyes (anterior row above), No. 131.
Fig. 14—Patella of leg III, anterior face, No. 195.
Fig. 15—(P) Tarsus of pedipalps, No. 60.
(I) Tarsus and metatarsus of leg I, No. 60.
Fig. 16—Coxa of pedipalp, ventral face, No. 60.

Aptostichus stanfordianus ♀ (Figs. 17–29).

Fig. 17—Coxa of pedipalp, ventral face, No. 120.
Fig. 18—Patella of leg III, anterior face, No. 120.
Fig. 19—Eyes (anterior row above), No. 137.
Fig. 20—Eyes (anterior row above), No. 213.
Fig. 21—Eyes (anterior row above), No. 187.
Fig. 22—Eye-tuber, lateral aspect, No. 137.
Fig. 23—Eye-tuber, lateral aspect, No. 213.
Fig. 24—Eye-tuber, caudal aspect, No. 137.
Fig. 25—Tarsal claws, leg I, inner faces, No. 120.
Fig. 26—Tarsal claws, leg II, inner faces, No. 120.
Fig. 27—Tarsal claws, leg III, inner faces, No. 120.
Fig. 28—Tarsal claws, leg IV, inner faces, No. 120.
Fig. 29—(P) Tarsus and "tibia" of pedipalp, No. 228.
(I) Tarsus and metatarsus of leg I, No. 228.
(II) Tarsus and metatarsus of leg II, No. 228.

Aptostichus atomarius ♀ (Figs. 30–32.)

Fig. 30—Eye-tuber, caudal aspect, No. 209.
Fig. 31—Eye-tuber, lateral aspect, No. 209.
Fig. 32—Eyes (anterior row above), No. 209.

EXPLANATION OF PLATE XV.

Aliatypus californicus (Figs. 1–6).

Fig. 1—Ventral aspect of ♂ (abdomen omitted), No. 100.
Fig. 2—Lateral aspect of ♂, No. 100.
Fig. 3—Pedipalps of ♂, No. 100.
Fig. 4—Genital bulb, four aspects, showing "conductor" in "c" and "d", No. 100.
Fig. 5—Ventral aspect of ♀ (abdomen omitted), No. 32.
Fig. 6—Lateral aspect of ♀ (abdomen omitted), No. 32.

Atypoides riversi (Figs. 7–9.)

Fig. 7—Lateral aspect of ♀ (abdomen omitted), No. 317.
Fig. 8—Lateral aspect of ♂ (after Cambridge.)
Fig. 9—Pedipalp of ♂ (after Cambridge.)

EXPLANATION OF PLATE XVI.

Fig. 1—Eutychides versicolor ♀
Fig. 2—Eutychides versicolor ♂
Fig. 3—Aptostichus atomarius ♀.
Fig. 4—Aptostichus stanfordianus ♀ (under alcohol).
Fig. 5—Aptostichus stanfordianus ♀ (regenerated leg I).

EXPLANATION OP PLATE XVII.

Fig. 1—Eurypelma californica ♂
Fig. 2—Eurypelma californica ♀.

EXPLANATION OF PLATE XVIII.

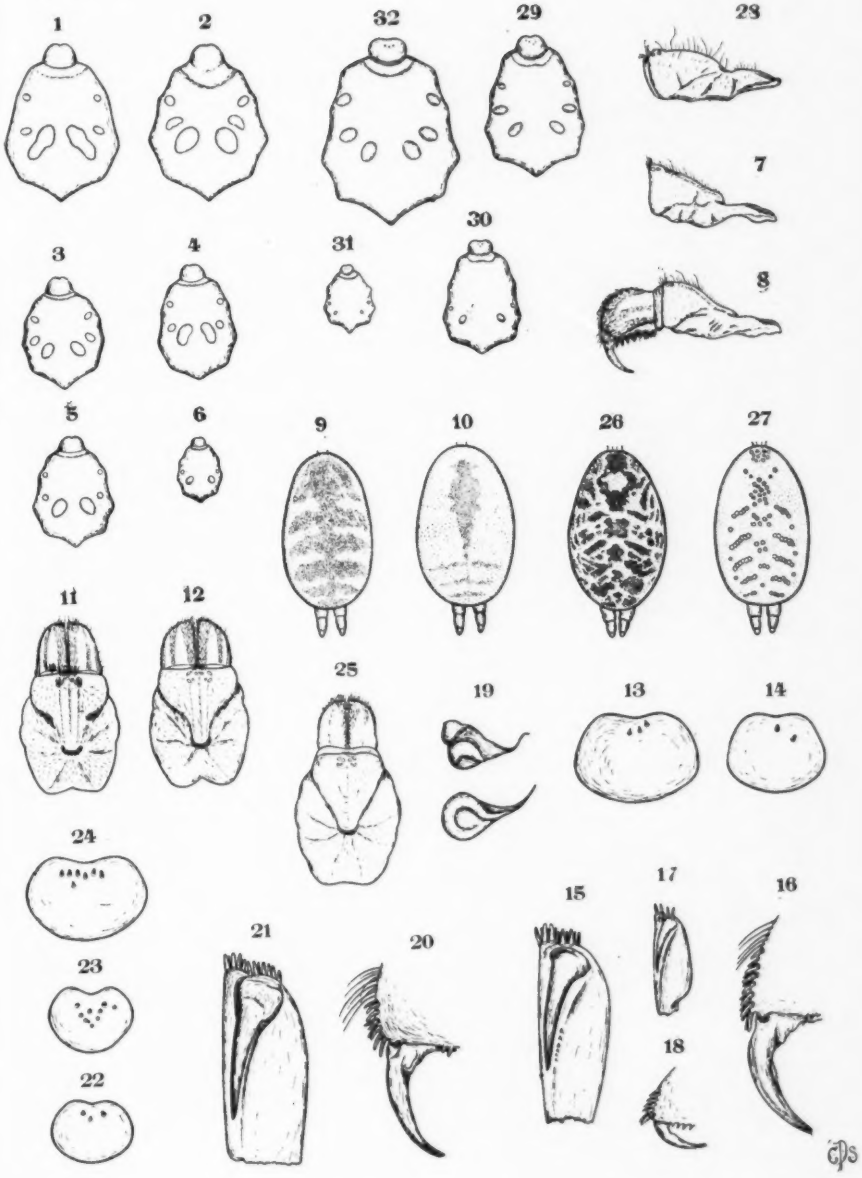
Fig. 1—Bracyhthele longitarsis ♂ (regenerated palpus).
Fig. 2—Brachythele longitarsis ♀ (regenerated leg I).

EXPLANATION OF PLATE XIX.

Fig. 1—Brachythele longitarsis ♀ (from life).
Fig. 2—Atypoides riversi ♀.
Fig. 3—Aliatypus californicus ♂.
Fig. 4—Aliatypus californicus ♀.

EXPLANATION OF PLATE XX.

Fig. 1—Brachythele longitarsis, web-covered hole.
Fig. 2—Brachythele longitarsis, open hole in grass.
Fig. 3—Atypoides riversi, turret with pine-needles.
Fig. 4—Atypoides riversi, turret with moss, etc.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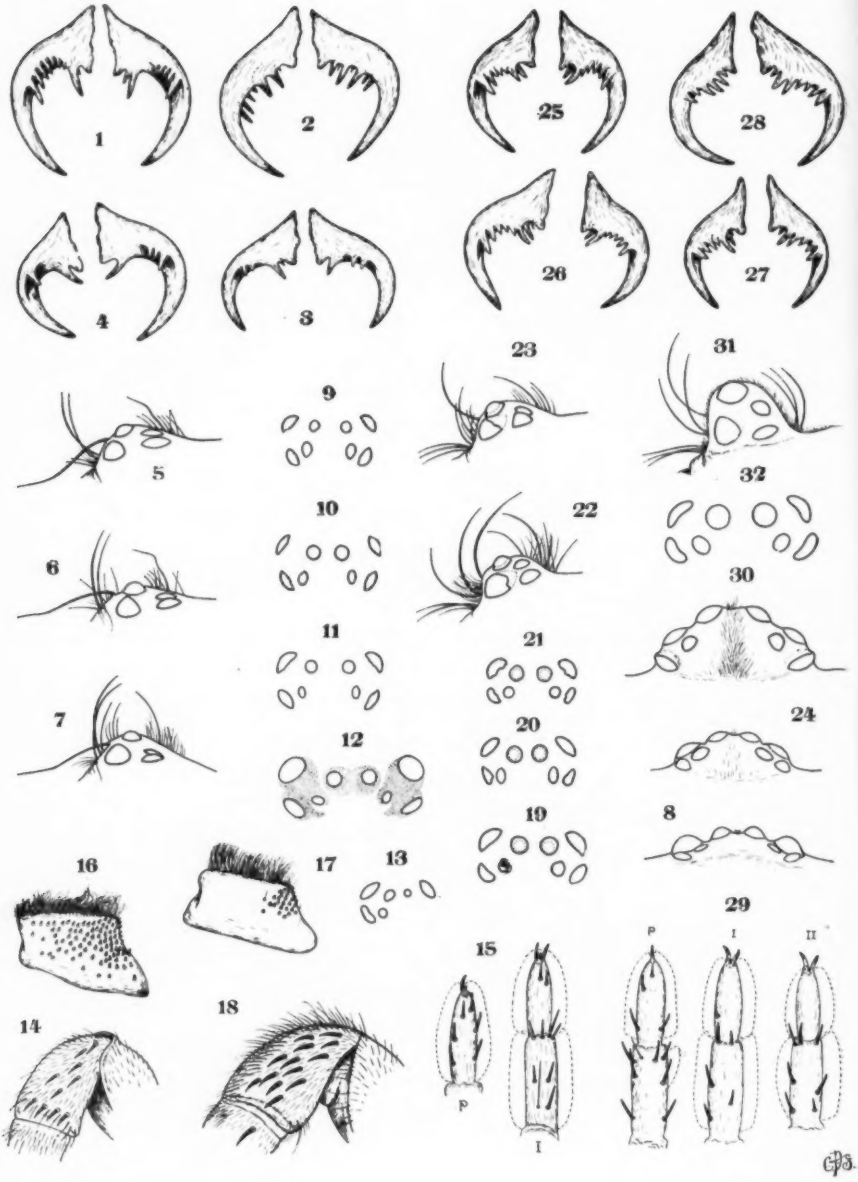
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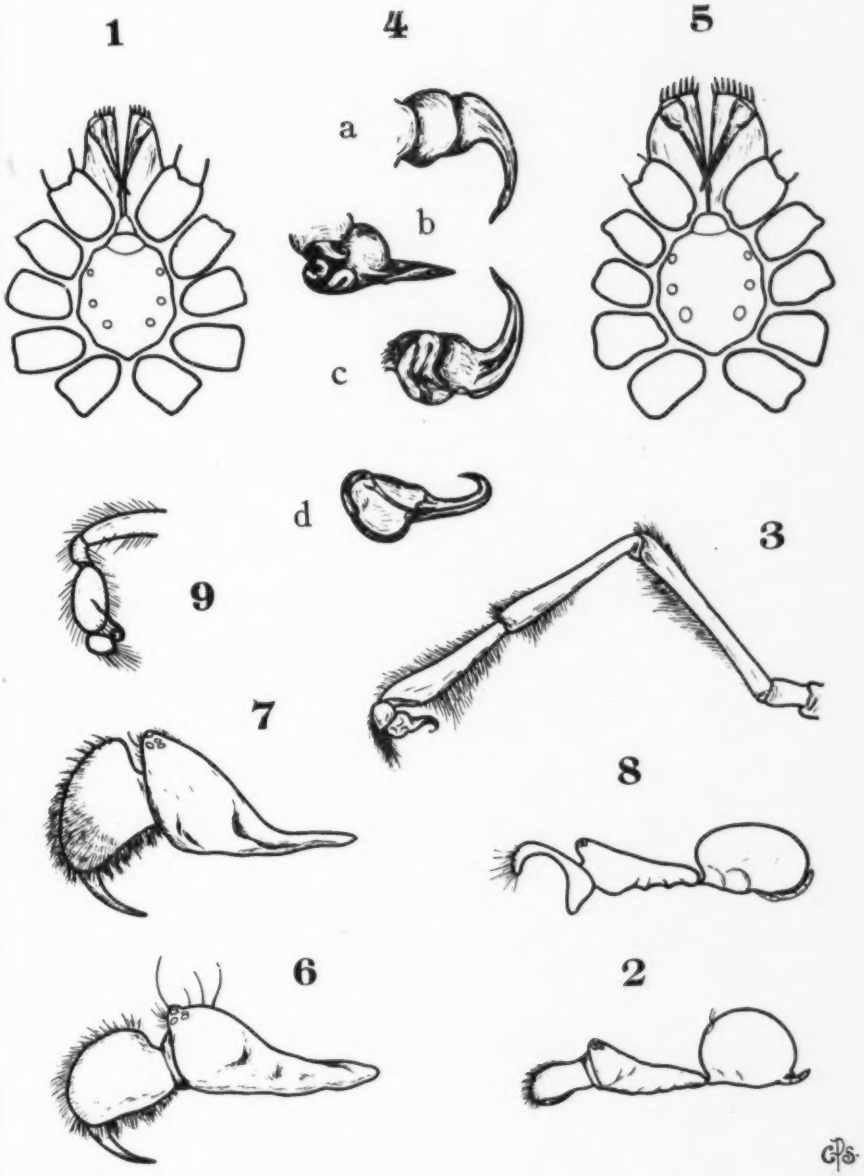

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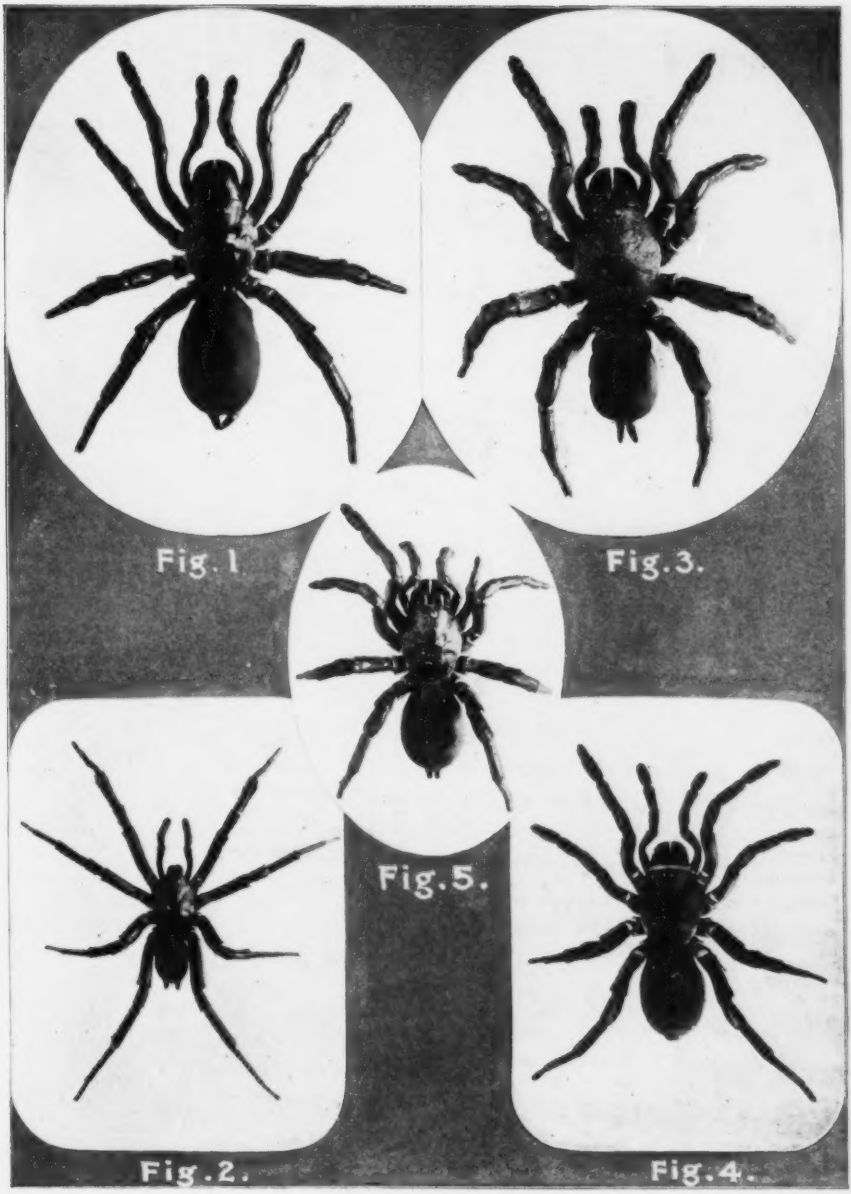

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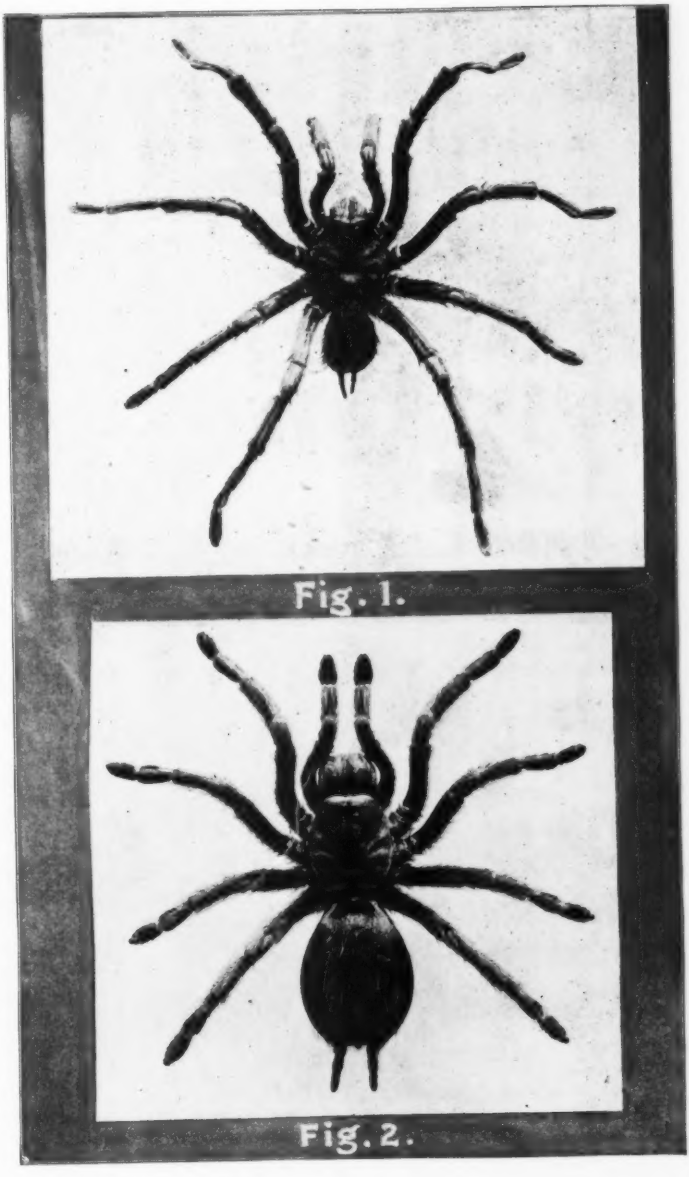

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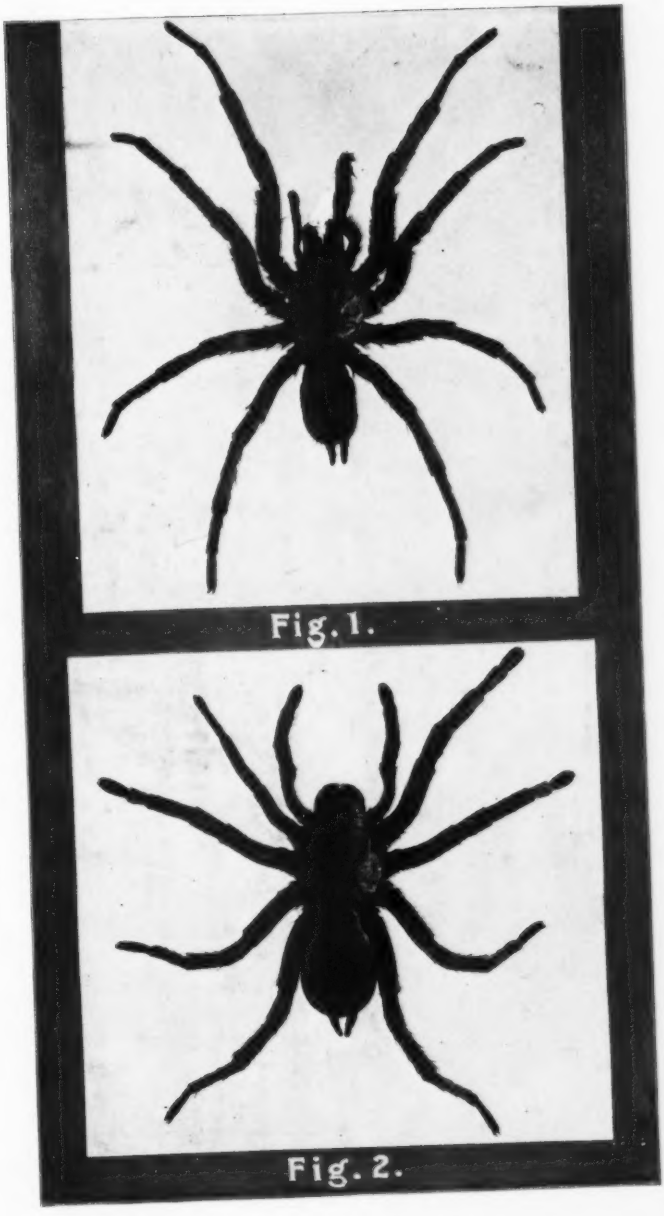

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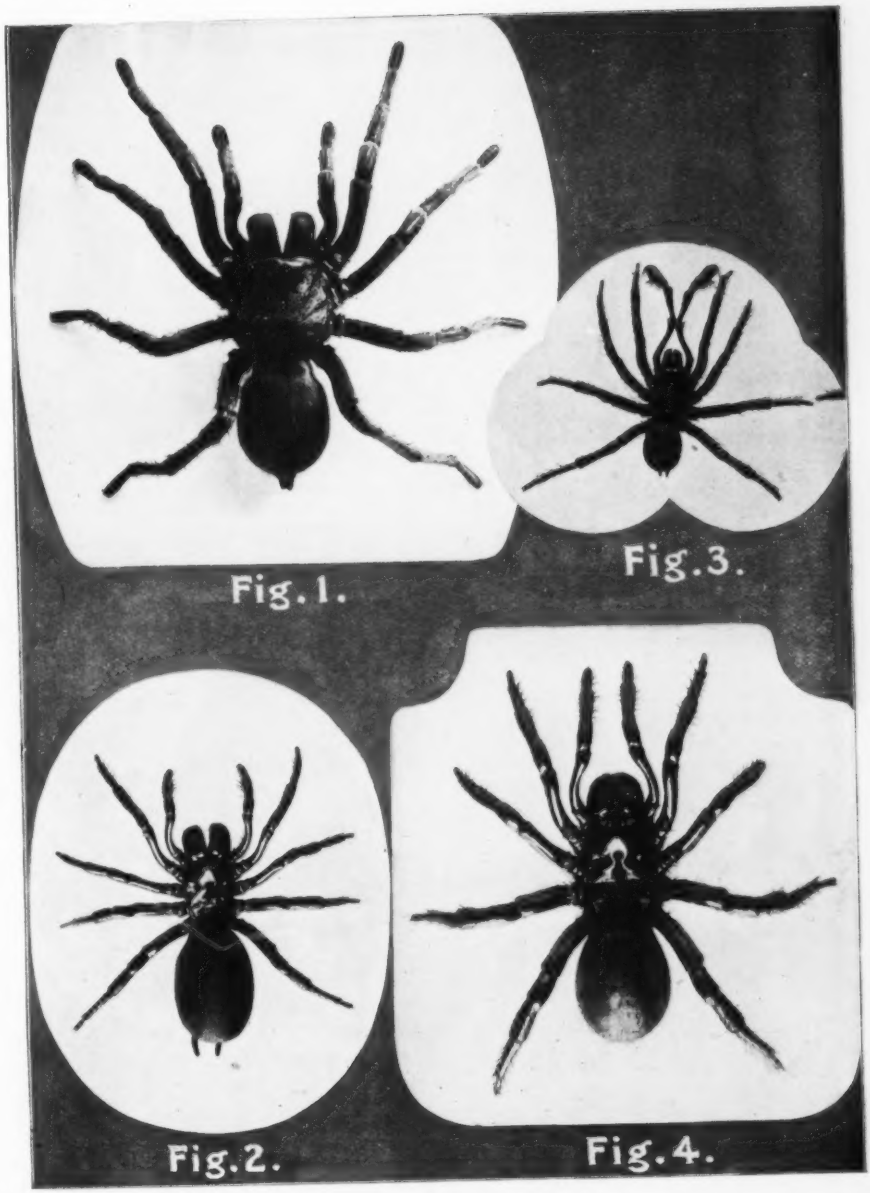

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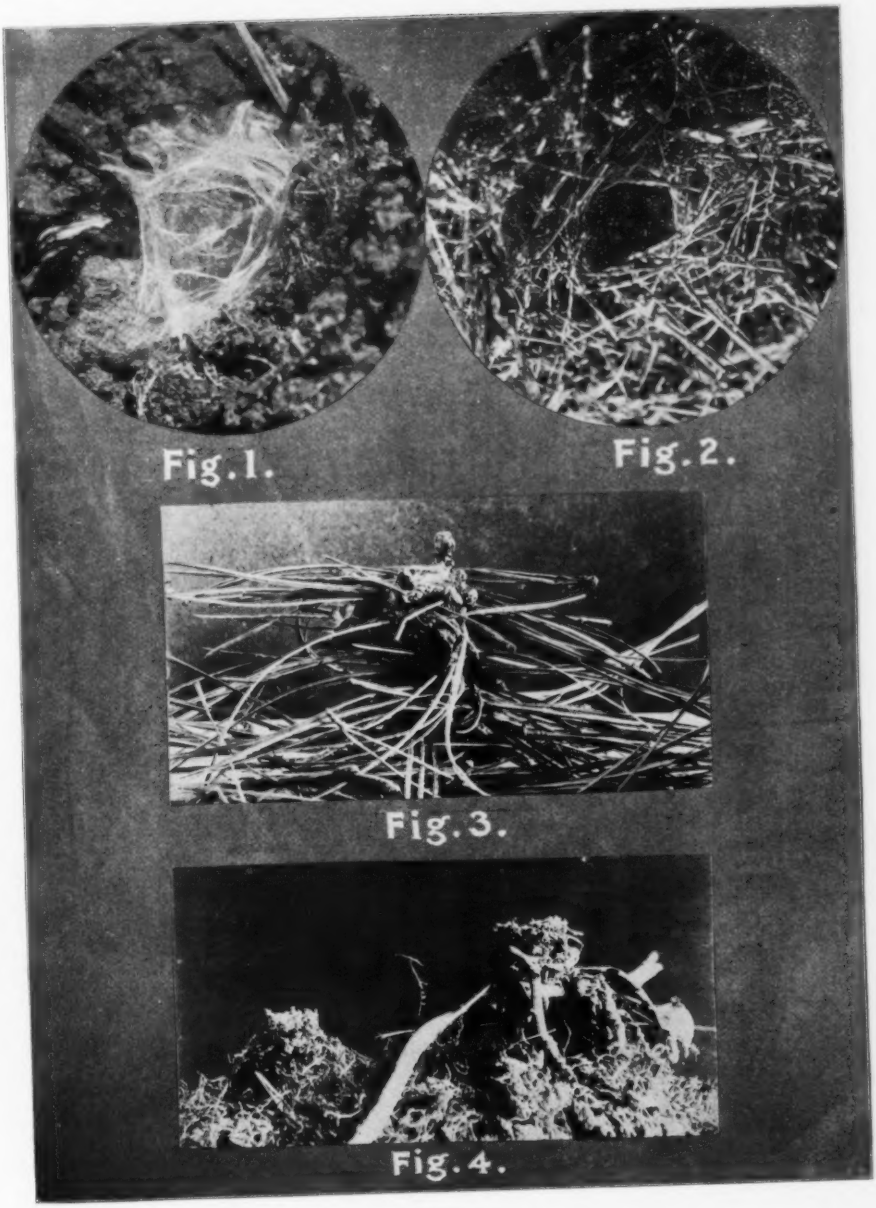
Fig. 1.
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STUDIES ON APHIDIDÆ. I.*

By John J. Davis,
Office of the State Entomologist, Urbana, Ill.

Myzus elæagni Del Guercio.

I first found this aphid at Urbana, Ill., November 16, 1907, common on the ornamental Russian olive tree (Elæagnus angustifolia). At that time only the sexual forms (wingless oviparous females and winged males) and the jet-black eggs were found, the latter being common on the branches, along and in the axils of the buds. A week later the same species was found on Shepherdia argentea.

Early this year (January 18, 1908) a branch of Elæagnus bearing many eggs was placed in a warm insectary, the branch being placed in water to keep it fresh. These eggs were first noticed hatching February 2, fifteen days after being brought into the warm room, and at about the same time at which the leaf-buds began to expand. (The temperatures, taken with a thermograph at midnight, 6 A. M., noon, and at 6 P. M., gave an average of 59.2° F. for the period between the time the eggs were brought into the insectary until they commenced hatching.) In the warm insectary, the stem-mothers, or fundatrices, were first observed producing young February 14, and on February 21 the first migrants of the second generation were found. These migrants would usually fly from the original food plant immediately upon becoming winged, and this, with the fact that I have never found it on Elæagnus during the summer, and that Professor C. P. Gillette has collected it on thistle, indicates that this aphid has a regular alternate food plant.

Myzus elæagni was first found in Europe and described by Doctor Del Guercio in Il Naturalista Siciliano, Vol. XIII, p. 197 (1894). I have not seen the original description, nor have I examined European specimens, but specimens from Illinois were sent to Doctor Del Guercio, who kindly determined them as his M. elæagni. In the Canadian Entomologist, Vol. XL., p. 17 (1908),

* The object of these studies has been to learn the winter histories of little-known species of Aphididæ, and to describe the various sexual forms heretofore unpublished; also to redescribe species which may have been only briefly described.

Professor Gillette described this species as M. braggii. His specimens were collected on Canada thistle (Carduus arvensis), and he has since written me that he also collected it this spring (1908) on Elæagnus, and that he had found it on this tree only in the spring previous to July 1, which agrees with the observations of Mr. J. T. Monell and myself. Mr. Monell sent me specimens of a Myzus on a hardy Elæagnus which proved to be of the same species as those collected in Colorado and Illinois. These specimens were collected May 10–13, 1907, at St. Louis, Mo., and Mr. Monell writes that he has not found it after that date. This year (1908) I first found winged migrants on Elæagnus at Chicago, Illinois, September 17, and each had given birth to several young of the sexual generation.

DESCRIPTION.

Under the name, Myzus braggii, n. sp., Professor C. P. Gillette has described (Canadian Entomologist, January, 1908) the winged male, and winged and wingless viviparous females, and further descriptions of these stages are unnecessary.

"Winged viviparous female, second generation from egg.—(Bred on Elæagnus angustifolia)—Head dusky; on the front and between the bases of the antennæ are a few capitate hairs, and also a conspicuous prominence bearing the cephalic ocellus; the frontal (antennal) tubercles slightly gibbous. (Pl. XXI, fig. 6.) Antennæ dusky to black, excepting the two basal segments, which are concolorous with the head; irregularly placed sensoria as follows: 14–39 (usually 25–35), on III., 7–17 on IV., 4–7 on V., and several smaller ones at the distal end of the basal portion of VI.; subequal to the body in length; the first segment gibbous. (Pl. XXI, fig. 3.) Eyes dark red. Beak dark at tip, and not reaching beyond the coxæ of the second pair of legs. Thoracic plates light to darker brown. Wings hyaline, the first and second discoidals usually branching at about one half or slightly less, the distance from the margin to the third discoidal. (Pl. XXI, fig. 1.) Legs dusky and with a greenish tint, excepting the articulations, which are darker, and the apical ends of the tibiæ and the tarsi, which are black. Abdomen pale greenish, or yellowish green, with a darker quadrangular blotch on the dorsum. Cornicles with the distal third incrassate; pale and almost transparent, excepting the incrassated portion, this being dusky; extending beyond the tip of the abdomen. (Pl. XXI, fig. 8.) Style pale and with a greenish tint, more or less ensiform in shape, and about equal to the hind tarsus in length.

Measurements.—(The extreme, as well as the averages, from many specimens measured, are given.) Length of body, 1.23 – 1.52 mm.; width, 0.472–0.509 mm.; length of wing, 2.00–2.50 mm.; width, 0.72–0.90 mm.; wing expanse, 4.70–5.60 mm.; antenna, I, 0.0652; II, 0.0489; III, 0.2771–0.4075, average, 0.3317; IV, 0.1467–0.2445, average, 0.2021; V, 0.1304–0.2282, average, 0.1793; VI, basal, 0.0815–0.0978, average, 0.0896; VI, filament, 0.4401–0.6909, average 0.5676; average total, 1.4844; mm. cornicles, 0.2445–0.3586, average, 0.3015 mm.; style, 0.0978 mm.; tarsus, 0.0978 mm.

Wingless viviparous female.—(Reared from eggs collected on Elæagnus angustifolia). General body color cream yellow, the thorax and abdomen with two longitudinal rows of more or less oblong, bright green markings. Head with a number of capitate hairs projecting from the front. The two basal segments of the antennæ almost clear transparent or with a slight greenish tint; the others, except the last two segments, which are dusky, are pale green.

Antennae not more than one half the length of body; borne on gibbous tubercles; the first segment gibbous and with a single capitate hair projecting from the prominence; the articulation between the third and fourth segments absent or indistinct in the specimens reared in the insectary. (Pl. XXI, fig. 5.) Eyes dark red. Beak not reaching beyond the coxæ of the middle pair of legs. Coloration of legs as follows: femora light green, tibiæ pale greenish, excepting the tip, which is slightly dusky; tarsi black. The last two segments of the abdomen with a number of capitate hairs projecting caudad. Cornicles almost transparent and with a faint greenish tint, incrassate, and reaching to the tip of the abdomen. Style pale green, and ensiform in shape. (Pl. XXI, fig. 7.)

Measurements.—(Averages.) Length of body, 1.6119 mm.; width, 0.7898 mm.; antenna, I, 0.0631; II, 0.0368; III and IV, 0.3390; V, 0.1450; VI, basal, 0.0896; VI, filament, 0.2445; total, 0.9180 mm.; cornicles, 0.3912 mm.; style, 0.1630 mm.; tarsus, 0.0978 mm.

Immature.—The young when first hatched from the eggs are brown, with a slight tint of dull orange, and they very closely resemble the rusty leaf patches, present, at this stage of development, on the Elæagnus leaves. The young of the second instar of this fundatrix generation are pale yellowish green, and of about the same color as the leaves, the latter by this time having lost most of the brownish patches and become more of a solid pale green color. This would appear to be a case of protective resemblance.

Wingless oviparous female.—Head pale green, and bearing a few capitate hairs on the front. Antennæ borne on gibbous tubercles, and the first segments likewise gibbous; dusky, excepting the first two segments and the basal portion of the third, which are pale green; usually reaching to the bases of the cornicles; the usual circular sensorium at the distal end of V, and several at the apex of the basal portion of VI; the articulations of the third and fourth segments indistinct, and sometimes invisible. (Pl. XXI, fig. 4.) Eyes dark red. Abdomen and thorax of the general dark coloration, having a mottled appearance and consisting of greens, reds, and blacks; and bearing a few capitate hairs. Under magnification there appear three more or less distinct longitudinal lines of this dark color mixture on the dorsum, one on the median line and one on either side; also, the last few segments are solidly of this color. Legs pale green, excepting the articulations and the tarsi, which are dark to black; the basal two thirds of the hind tibiæ swollen and bearing numerous circular sensoria. (Pl. XXI, fig. 9.) Cornicles incrassate, and reaching to tip of abdomen; pale green, and darkening at tips. Style ensiform and of a pale dirty-green color.

Measurements.—(Averages.) Length of body, 1.6726 mm.; width, 0.8363 mm.; antenna, I, 0.0652; II, 0.0489; III, 0.2445; IV, 0.1483; V, 0.1597; VI, basal, 0.0880; VI, filament, 0.4939; total, 1.2405 mm.; cornicles, 0.3830 mm.; style, 0.1711; mm. tarsus, 0.0978 mm.

Young of the first three instars are light green in color, but the immature aphids of the fourth instar are pale yellow with bright green spots scattered over the body in longitudinal rows, as are the dark markings in the adult.

Eggs.—Elliptical oval, greenish-yellow when first deposited and later changing to jet-black, and measuring 0.2443 by 0.5216 mm.

Winged male.—(No color notes were made and the following description is taken from specimens mounted in balsam.) Antennæ longer than body; borne on gibbous tubercles; the first segments likewise gibbous; irregularly placed circular sensoria as follows: 24–27 on III, 9–14 on IV, 2–4 on V, and several at the distal end of the basal portion of VI. (Pl. XXI, fig. 2.) Wings hyaline, the first and second discoidals branching about one third, or slightly more than one third, the distance from the margin of the wing to the third discoidal. Cornicles incrassate, and reaching beyond the tip of the abdomen. Style ensiform.

Measurements.—(Average.) Length of body, 1.2089 mm.; width, 0.6045 mm.; antenna, I, 0.0652; II, 0.0571; III, 0.4401; IV, 0.3097; V. 0.2553; VI, basal, 0.0978; VI, filament, 0.8150; total, 2.0402 mm.; cornicle, 0.3830 mm.; style, 0.1630 mm.; hind tarsus, 0.1141 mm.

The Barberry Plant-louse (**Rhopalosiphum berberidis** Kaltenbach)

Rhopalosiphum berberidis Kalt. was first noted and described as new in this country in 1851 by Asa Fitch, in his "Catalogue of the Homoptera of New York." He later gave the complete life history of the species, under the name of Aphis berberidis Kalt., in the "Tenth Report of the Insects of New York." It has also been mentioned in the writings of Walsh, Thomas, Oestlund, and Hunter, but has never been reported outside of New York.

Mr. J. T. Monell has kindly sent me specimens of this species, collected by him in St. Louis, Mo., and I have frequently found it in Illinois. Mr. Paul Hayhurst writes that he has found it common in Massachusetts.

Fitch reported it from Berberis vulgaris, this being likewise the only known food plant in Illinois. In Europe it was found by Kaltenbach on Berberis vulgaris, and by Buckton on B. communis.

I first found this aphid at Urbana, Ill., about the middle of June, 1907, on the stems and on the undersides of the leaves of Berberis. It continued to be very abundant until about the first of August, when it became comparatively scarce, although at no time during the entire summer were the plants free from this aphid. During October they again became numerous, and November 14 I found the sexual forms, although at this time most of them were immature. On this date, eggs also were found, these being deposited in the crevices of the bark and in the grooves between the buds and stem.

This spring (1908) I first examined these plants March 18, and on that date found the eggs all hatched and the reddish-brown immature stem-mothers numerous upon the stems, although the buds had not yet opened. Eggs of a number of other aphids were observed this spring, but those on the Berberis were the first to hatch, the eggs of the other species not hatching until about a week later.

Adult stem-mothers were first noticed March 25, and the first winged adults of the second generation eight days later, April 2. Although most of the second generation became winged, many were wingless upon becoming adult. The immature individuals, as well as the adults of this first generation differ in coloration from the immature and adults of the succeeding generations, as will be seen from the following descriptions

DESCRIPTIONS.

Wingless viviparous female, stem-mother.—General appearance, to the naked eye, orange. Head and thorax almost entirely bright orange. Antennæ white or nearly so, excepting the tips, which are dusky. Legs concolorous with antennae, excepting the tarsi, which are dark. Abdomen with two lateral, longitudinal stripes of orange, the central dorsum pale greenish or yellowish with longitudinal streaks of orange, the last three abdominal segments entirely orange. Cornicles pale whitish, except the extreme tips. Style orange-yellow. Otherwise as the wingless viviparous females of the succeeding generations, excepting the measurements of the total length and width, the stem-mothers usually being the greater.

The immature stem-mothers (first and second instars) are reddish brown, with dark (almost black) markings, as follows: two longitudinal rows of bars along the median dorsum and only separated by a fine median line of the body color; and two longitudinal rows of spots, one on each of the lateral margins. Head very dark, with a fine median line dividing the dark area into two patches. Antennæ dusky.

The aphids of the fourth instar of the first generation are very similar to the adults in color, except that the markings are not such a bright orange and the body is covered with more or less of a bloom.

Winged viviparous female.—General body color yellow. Antennæ slightly dusky and faintly imbricate; not reaching beyond the bases of the cornicles; segment III subequal to VI (= VI + VII of some authors), segments IV and V subequal and their combined length about equal to that of III, the basal portion and filament of VI subequal; irregularly placed circular sensoria as follows: 18–24 on III, 3–7 on IV, 3–5 on V, and several at the distal end of the basal portion of VI. (Pl. XXII, fig. 15.) Eyes appearing black to the naked eye, but under magnification they appear dark- or red-brown. Ocelli brown and distinct upon the yellow back-ground. Wings hyaline; the first and second discoidals branching at about one-third the distance from the margin to the third discoidal. (Pl. XXII, fig. 12.) Legs pale yellowish, except the tarsi and the distal ends of the tibiæ, which are dusky. Abdomen a paler yellow than the head and thorax. Cornicles concolorous with the body, excepting the distal ends, which are often slightly dusky; reaching to or slightly beyond the tip of abdomen; basal third very narrow and the remaining two thirds strongly incrassate, the tips slightly imbricate and flaring. Style concolorous with the body, conical, and slightly more than one third the length of the cornicles. (Pl. XXII, fig. 13.)

Measurements.—(Measurements from specimens mounted in balsam.) Length of body, 1.40 mm.; width, 0.51 mm.; length of wing, 2.8361 mm.; width, 1.0544 mm.; wing expanse, 5.50 mm.; antenna, I, 0.0652; II, 0.0570; III, 0.3260; IV, 0.1847; V, 0.1901; VI, basal, 0.1548; VI, filament, 0.1662; total, 1.1440 mm.; cornicles, 0.3423 mm.; style, 0.1385 mm.; hind tarsus, 0.1141 mm.

Wingless viviparous female.—(Summer form.) General color bright yellow and often with a slight greenish tint. Antennæ whitish-yellow; the third segment very faintly imbricate and the remaining segments with increasing imbrication; segment III subequal to, or slightly less than, VI (base + filament), IV and V subequal, and their combined length equal to, or slightly greater than, VI.; about one-half the length of the body; the usual sensorium near the apex of V, and several at the distal end of the basal portion of VI. (Pl. XXII, fig. 17.) Eyes red. Legs whitish yellow. Cornicles concolorous with the body; the basal third narrow and the remaining two-thirds strongly incrassate, the tip being more or less flaring; reaching to or slightly beyond the end of the abdomen. (Pl. XXI, fig. 11.) Style concolorous with the body, conical, and between one-half and one-third the length of the cornicles.

Measurements.—(Taken from specimens mounted in balsam.) Length of body, 1.5453 mm.; width, 0.7817 mm.; antenna, I, 0.0652; II, 0.0489; III, 0.1956; IV, 0.1304; V, 0.1355; VI, basal, 0.1110; VI, filament, 0.1418; total, 0.8284 mm.; cornicles, 0.3830 mm.; greatest width of cornicles, 0.0896 mm.; style, 0.1548 mm.; hind tarsus, 0.1222 mm.

Wingless oviparous female.—Head pale dirty green and with a median prominence projecting anteriorly. Antennæ dusky and faintly imbricate; one sensorium near the extremity of V, and several at the distal end of the basal portion of VI; placed on frontal tubercles, and the first segment somewhat gibbous; about one-half the length of the body; (Pl. XXII, fig. 16.) Eyes black. Beak reaching to the coxæ of the second pair of legs. Dorsum of prothorax almost entirely covered with a colored patch, the coloration being a mixture of red, brown, and black, intermixed with lighter colors; other thoracic segments with a similar coloration, but the bars of color are broken along the median line. Legs dusky, excepting the basal halves of the femora, which are pale green; the hind tibiæ very noticeably swollen and bearing many circular sensoria. (Pl. XXI, fig. 10.) The three anterior segments of the abdomen with markings similar to those on the meso- and metathorax; the remaining segments with darker markings which are more or less contiguous, and appear as a large dark patch on the dorsum. Cornicles green at the bases and becoming dusky at the tips, extending almost to the end of the abdomen; and the distal two-thirds strongly incrassate. Style pale dirty green, conical, and less than half the cornicles in length.

Measurements.—(Taken from specimens mounted in balsam.) Length of body, 2.0798 mm.; width, 1.0544 mm.; antenna, I, 0.0733; II, 0.0570; III, 0.2559; IV, 0.1695; V, 0.1768; VI, basal, 0.1255; VI, filament, 0.1532; total, 1.0112 mm.; cornicles, 0.4352 mm.; style, 0.1793 mm.; hind tarsus, 0.1304 mm.

Eggs.—The elliptical-oval eggs are orange-yellow when first laid, but gradually change to a jet black.

Winged male.—Head black and with gibbous frontal tubercles. Antennæ black, except the two basal segments; reaching beyond the tip of the abdomen; segment I gibbous, III the longest, and the last three more or less imbricate; irregularly placed sensoria as follows: 19–29 on III, 5–10 on IV, 5–7 on V, and several at the distal end of the basal portion of VI. (Pl. XXII, fig. 14.) Eyes black. Thoracic plates black. Wings hyaline and with dark veins; the first and second discoidals branching about one third (sometimes varying to one half) the distance from the margin to the third discoidal. Legs dirty yellow, except the articulations, which are dark, and the tarsi, which are black. Abdomen yellow with black transverse bars, the anterior ones being broken along the median line. Cornicles concolorous with the abdomen and darkening towards the apex, extending beyond the tip of the abdomen; distal two-thirds strongly incrassate, and the tip more or less flaring. Style dusky to black, conical, and slightly longer than the hind tarsus.

Measurements.—(Taken from specimens mounted in balsam.) Length of body, 1.2784 mm.; width, 0.5360 mm.; length of wing, 2.5997 mm.; width, 1.0425 mm.; wing expanse, 5.6449 mm.; antenna, I, 0.0652; II, 0.0570; III, 0.4373; IV, 0.2934; V, 0.2836; VI, basal, 0.1752; VI, filament, 0.2315; total, 1.5432 mm.; cornicles, 0.3260 mm.; style, 0.1276 mm.; hind tarsus, 0.1167 mm.

Male pupa.—Entire body pale greenish-yellow. Eyes dark red-brown.

The Yellow Clover Plant-louse (**Callipterus trifolii** Monell).

This yellow Callipterus is common in all parts of Illinois, living solitary, usually on the undersides of the leaves of red clover (Trifolium pratense). C. trifolii was first described by Mr. J. T. Monell in the Canadian Entomologist, Vol. XIV, p. 14 (1882), from specimens collected in Washington, D. C., June 8, 1880. In the literature it has been reported from Iowa (Osborn and Sirrine), and from Delaware (Sanderson). I have received specimens from Mr. Paul Hayhurst, collected in Minnesota, and he writes that he has also found it in Kansas, Minnesota, North Dakota, and Virginia. Mr. Monell writes that he has found it in

Missouri, and Doctor J. W. Folsom found it on clover in New York, July 22, 1908.

Heretofore it has been stated that individuals of the genus Callipterus always become winged before reproducing viviparously. This characteristic does not always hold true for C. trifolii, for I have found wingless individuals giving birth to young. As a rule, however, most of the young are produced by winged individuals.

DESCRIPTIONS.

Wingless viviparous female.—General color of body pale green with a faint yellowish tint, and with dusky tubercular spots on the dorsum. Antennae pale whitish green at base, but becoming dusky and black towards the apex; very faintly imbricate, as long as, or slightly longer than, body, 9–12 sensoria in a row on segment III. (Pl. XXIII, fig. 30.) Eyes dark red. Beak not reaching beyond the coxæ of the second pair of legs. Legs pale, excepting the joints, which are dusky, and the tarsi, which are black. The six longitudinal rows of tubercles as in winged form, excepting that they are more prominent and bear conspicuous capitate hairs. Cornicles and style as in winged individual.

Measurements.—(From specimens in balsam, collected on Trifolium pratense at Urbana, Ill., September 4, 1907.) Length of body, 1.49–1.67, average 1.60 mm.; width, 0.72–0.83, average, 0.76 mm.; antenna I, 0.076; II, 0.053; III, 0.489–0.554, average, 0.517; IV, 0.326–0.375, average, 0.347; V, 0.285–0.342, average, 0.316; VI, basal, 0.146–0.163, average, 0.156; VI, filament, 0.155–0.179, average, 0.162; total (average) 1.627 mm.; cornicles, 0.062 mm.; style, 0.171 mm. hind tarsus, 0.130 mm.

Winged viviparous female.—General color pale yellowish green, with dusky markings on the dorsum. Antennae concolorous at base and darkening towards apex, longer than body, with 10–12 sensoria in a row on segment III, and faintly imbricate. (Pl. XXIII, fig. 29.) Eyes dark red to brown. Beak not reaching to coxæ of second pair of legs. Wings hyaline; veins dark brown to black, with a very narrow border of brownish tint and with a small brown patch at apices of veins, basal half of stigmal vein obsolescent, terminal forks of discoidal branching at a point slightly less than one half the distance from where the discoidal first branches. (Pl. XXII, fig. 20.) Legs concolorous with body, excepting tarsi, which are nearly black. Abdomen with six longitudinal rows of dusky tubercles, three rows on each side of the dorsal median The tubercles of the two rows on each side of the median are oblong, and each tubercle bears two fine setæ. The other tubercles are more or less circular, and each bears but one setæ. Cornicles (Pl. XXII, fig. 1) and style (Pl. XXII, fig. 21) somewhat dusky, the former tubercular and the latter globular.

Measurements.—(From specimens in balsam, collected on Trifolium pratense at Urbana, Ill., August 25 and September 4, 1907.) Length of body, 1.345–1.564, average, 1.454 mm.; width, 0.582–0.691, average, 0.642 mm.; expanse of wings, 4.654 mm.; length of wing, 2.045 mm.; antenna, I, 0.077; II, 0.055; III, 0.489–0.538, average, 0.516; IV, 0.358–0.391, average, 0.368; V, 0.301–0.358, average, 0.320; VI, basal, 0.146–0.179, average, 0.167; VI, filament, 0.146–0.179, average, 0.162; total (average), 1.665 mm.; cornicles, 0.066 mm.; style, 0.139 mm.; hind tarsus, 0.129 mm.

The following table gives comparisons of the average lengths (in millimeters) of the antennal segments of the type specimens, specimens from Mr. Hayhurst and the Illinois specimens. The measurements of the type specimens and of those collected by Mr. Hayhurst were made by Mr. Monell, who has kindly sent them for my use.

	I	II	III	IV	V	VI basal	VI filament	Total length
Monell's Types, Washington, D. C., June 8, 1880.....	0.057	0.046	0.448	0.312	0.287	0.153	0.135	1.438
Hayhurst's Specimens, Arlington, Va., June 28, 1907.....	0.07	0.050	0.492	0.292	0.264	0.143	0.150	1.461
Davis's Specimens, Urbana, Ill., Aug. 25 and Sept. 4, 1907.....	0.077	0.055	0.516	0.368	0.320	0.167	0.162	1.665

Wingless oviparous female.—General color yellow orange, when fully mature. When they first become adult the body is usually entirely yellow, but as the eggs, which are of an orange color, begin to develop within the body they show through the semi-transparent skin and give the orange tint to the body. Head pale yellow. Antennæ, at base, concolorous with head, and darkening towards the apex; not reaching to base of cornicles, and with about 8 or 10 circular sensoria in a row on segment III. (Pl. XXIII, fig. 32.) Eyes black. Prothorax pale yellow, meso- and metathorax varying from yellow to orange, according to age since maturity. Legs pale yellowish except tarsi; proximal half of hind tibiæ swollen and with 25 to 40 inconspicuous circular sensoria. (Pl. XXIII, fig. 33.) Dorsum of abdomen with longitudinal rows of darkened tubercular spots, three on each side of the median, the spots of the two rows, along the median are oval and usually bear two setæ, arising from conspicuous tubercles, while the spots of the remaining four rows are circular and but one setæ arises from each. Cornicles concolorous and tubercular.

Measurements.—(From specimens in alcohol and balsam, taken on Trifolium pratense at Urbana, Ill., November 15 and 26, 1907.) Length of body, 1.636–2.072, average, 1.848 mm.; width, 0.737–0.992, average, 0.864 mm.; antenna, I, 0.070; II, 0.060; III, 0.358–0.473, average, 0.407; IV, 0.179–0.236, average, 0.199; V, 0.179–0.228, average, 0.207; VI, basal, 0.122–0.146, average, 0.133; VI, filament, 0.138–0.147, average, 0.142; total (average), 1.218 mm.; cornicles, 0.061 mm.; hind tarsus, 0.134 mm.

Egg.—The egg is elliptical, of a bright orange color when first laid, and measures 0.578 mm. in length by 0.252 mm. in width. The average number of eggs found in the abdomens of a number of specimens examined was 10.

Winged male.—Head and thorax light olive green, abdomen pale yellow green with conspicuous black markings. Antennæ black, excepting two basal segments, as long as body, and with circular sensoria on segments III, IV and V, as follows: 12–15 in a row on III, 2–4 on IV, and 3–5 on V. (Pl. XXIII, fig. 31.) Eyes black. Beak black at tip and not reaching to coxæ of middle pair of legs. Wings hyaline, with dark wing veins slightly margined with brown, and a very small brownish patch at end of each vein; stigmal vein obsolescent; the terminal fork of the discoidal branching at about one half the distance from the margin to where the discoidal first branches. Abdomen with a longitudinal row of large, black, oval spots on each side of the dorsal median line, and each spot bearing one or two very fine setæ; also there is a similar row of smaller setiferous spots on each side, and between these markings and those on the dorsal median are a few scattered and irregularly placed spots. Cornicles tubercular and dusky. Style globular, dusky, and edged with black.

Measurements.—(From four males; two in balsam taken on Trifolium pratense, November 15, 1907, and the others reared in the insectary February 1, 1908, and measured immediately after mounting in balsam.) Length of body, 1.091 (body somewhat shrunken)—1.382, average, 1.261 mm.; width, 0.509–0.582, average, 0.536 mm.; expanse of wings, 4.1571 mm.; length of wings, 1.827 mm.; antenna, I, 0.068; II, 0.054; III, 0.472–0.554, average, 0.513; IV, 0.277–0.358; average, 0.309; V, 0.261–0.318, average, 0.292; VI, basal, 0.138–0.163, average, 0.153; VI, filament, 0.146–0.163, average, 0.156; total, 1.545 mm.; cornicles, 0.049 mm.; hind tarsus, 0.130 mm.

The Red-clover Aphis (**Aphis bakeri** Cowen).

While examining the base of a red-clover plant (Trifolium pratense) August 5, 1907, at Urbana, Ill., I noticed a colony of immature pinkish aphids, which were apparently being attended by the large black ant (Formica fusca L.) The aphids were upon the undersides of the stems close to the ground, and the ants had built a roof-like structure, composed of debris, over the stems, evidently for the protection of the aphids. The young aphids above mentioned were reared to adults and successive generations obtained. In the fall, an infested clover plant was placed in the cold insectary room—this having approximately the out-of-door temperature—where it remained until the middle of January, 1908. When examined at this date only pupæ were found, and these, when brought into a warm room, became winged and produced young. I have also found this species at Leroy, Ill., September 9, on T. pratense, and situated on the plant as were those found at Urbana, but they were attended by another species of ant (Cremastogaster lineolata Say). During 1908 I have found this species very common in fields and along roadways, on T. pratense and attended by several species of ants, namely, Lasius niger var. americanus, and the two species mentioned above. Here the aphids commonly infested the upper parts of the stems and the flowers, as well as the stems near the base.

Several generations were carried through in the insectary, and the following life-history notes taken: The number of young produced by an individual female was found to vary from 61 to 72, giving an average of 2 to 3 young per day, the largest number of young produced by a single female in one day being 7. Usually the female lives 6 or 8 days after the birth of the last young.

Because of the pinkish color of the immature individuals and the pseudo-subterranean habit, I determined the species tentatively as Aphis trifolii of Oestlund, which, in the original descriptions was characterized as a subterranean species found on Trifolium repens L., and with a pinkish color, no other definite characteristics being given. I sent specimens to Prof. O. W. Oestlund who examined them and wrote to me that he believed them to be the same species described by him some twenty years ago, and named Aphis trifolii; though he had never seen the adult form before, either spuriæ or migrants, and his original description was based only on the larvæ.

Later, having received specimens of Aphis bakeri Cowen from Prof. C. P. Gillette, I noticed the similarity between these and my

clover aphis. I accordingly sent Professor Gillette specimens, in regard to which he reported that they "seem to be identical with what we have been calling Aphis bakeri. A. bakeri is not a subterranean species, but it does work close about the bases of the plants, particularly during the colder portions of the year." He also stated that A. cephalicola Cow. was now considered a synonym of A. bakeri, and further that he had collected it on apple and Cratægus as well as on clover.

Last summer (1907) I received specimens of a clover aphis from Mr. Paul Hayhurst, which I determined as A. cephalicola, not knowing at the time that it was a synonym of A. bakeri. These specimens were collected in Minnesota and Mr. Hayhurst has written that he has also taken this species in Kansas and the District of Columbia.

I have used the name of A. bakeri as having priority, inasmuch as the incomplete description of A. trifolii was made from immature individuals only, and we can not be certain that this is the same species; although the pinkish coloration of some of the immature individuals, as well as pseudo-subterranean habit, suggests that they are what was described as A. trifolii.

DESCRIPTIONS.

Winged viviparous female.—General color black. Head jet black. (Pl. III, fig. 23.) Antennæ black, not reaching the cornicles, and with numerous unequal tuberculate sensoria, irregularly placed on segments III, IV, and V, as follows: 22–33 on III, 2–18 on IV and 1–11 on V (usually, however, but the one large distal sensorium on V), also several smaller ones at the distal end of the thickened base of VI; segment III usually the longest, but occasionally it is subequal to VI (= VI and VII of some authors), IV slightly shorter than the filament of VI, V about half the length of III, and the basal portion of VI about half the length of IV. (Pl. XXIII, fig. 24.) Eyes black. Beak not reaching beyond the coxæ of the middle pair of legs. Thorax jet black. Wings hyaline and with dark veins; the first and second discoidal usually branching at one half the distance from the margin to the third discoidal this, however, is more or less variable, the distance sometimes being greater, and sometimes less, than one half. (Pl. XXIII, fig. 22.) Legs almost entirely black. Abdomen more or less glossy and appearing black to the naked eye. Magnification shows a large, black patch covering most of the dorsum, and two rows of small black spots along the margin, one on each side; the remainder of the dorsum having a greenish tint. The black patch is solid, except one bar anteriorly, and several posteriorly, to it. (Sometimes the dorsal patch, instead of being almost an entire mass, is made up entirely of individual transverse bars.) Cornicles black, imbricated, and more or less flaring at the apex. (Pl. XXIII, fig. 26.) Style black, and conical. (Pl. XXIII, fig. 27.)

Measurements.—(Many specimens were measured, and the maximum and minimum, as well as the averages, are given. There is considerable variation in the actual measurements of the antennal segments, length of body, etc., between different individuals, but the relative lengths of the antennal segments, length of body, etc., are quite constant.) Length of body, 1.2726–1.8543, average, 1.4857 mm.; width, 0.6181–0.7979, average, 0.6825 mm.; length of wing, (average) 2.39 mm.; width, 0.88 mm.; antenna, I, 0.0682; II, 0.0565; III,

0.2934–0.4564, average, 0.3328; IV, 0.1548–0.2934, average, 0.1913; V, 0.1222–0.2282, average, 0.1462; VI, basal, 0.0815–0.1141, average, 0.0986; VI, filament, 0.2119–0.3423, average 0.2494; total (average), 1.1430 mm.; cornicles, 0.1032 mm.; style, 0.0788 mm.; hind tarsus, 0.1059. mm.

Pupa.—Head and thorax with a pinkish tint, and somewhat mottled, or pale green. Eyes black. Tip of beak black. Antennæ pale, excepting the last segment, which is dusky. Wing-pads pale with a greenish yellow tint. Legs pale. Abdomen dirty greenish, and sometimes with a yellowish or pinkish tint. Cornicles and style pale.

Wingless viviparous female.—The general body color, when examined with the naked eye, varying from dirty green or yellowish green to almost jet black. Head and portion of the thorax pale to dark dirty green. Antennæ about one half the body in length; the two basal segments dusky, the third pale, and the remaining segments darkening to black. (Pl. XXIII, fig. 25.) Eyes black. Legs, except the articulations and the tarsi, concolorous with the body coloration. Abdomen and posterior portion of the thorax dark dirty green to black green, and covered with many fine dark spots, which are scattered more or less irregularly over the dorsum. Around the cornicles is a semicircular immaculate area, and upon each of the last four abdominal segments is a more or less distinct transverse black band. Ventral surface of the abdomen immaculate, excepting a black blotch at the extreme posterior end. Cornicles pale, imbricate, and slightly flaring at the tips; subequal to the tarsus in length. The dorsally curved style pale, and with a dark margin, conical, and slightly less than the cornicles in length.

Measurements.—Length of body, 1.927–2.218, average, 2.127 mm.; width, 1.136–1.164, average, 1.146 mm.; antenna, I, 0.0621; II, 0.0516; III, 0.2282–0.3097, average, 0.2681; IV, 0.1304–0.2119, average, 0.1850; V, 0.1059–0.1630, average, 0.1418; VI, basal, 0.0733–0.0978, average, 0.0912; VI, filament, 0.1793–0.2526, average, 0.2192; total (average), 1.019 mm.; cornicles, 0.1263 mm.; style, 0.1121 mm.; hind tarsus, 0.1141 mm.

Sexual forms—The sexual generation has never been obtained, and from the data above it is evident that this species can hibernate in this latitude as viviparous individuals. Its alternate food plant, the apple, may possibly be the host upon which the sexual forms are produced, though Aphis bakeri has not as yet been found on apple in Illinois.

EXPLANATION OF PLATES.

Myzus elæagni Del G.—Plate XXI, figs. 1–9.

Figure 1, fore wing; 2, antenna of winged ♂; 3, of winged viviparous ♀; 4, of wingless oviparous ♀; 5, of wingless viviparous ♀; 6, head of winged viviparous ♀; 7, style of wingless viviparous ♀; 8, cornicle of winged viviparous ♀; 9, hind tibia of wingless oviparous ♀.

Rhopalosiphum berberidis Kalt.—Plate XXI, figs. 10–11; Plate XXII, figs. 12–18.

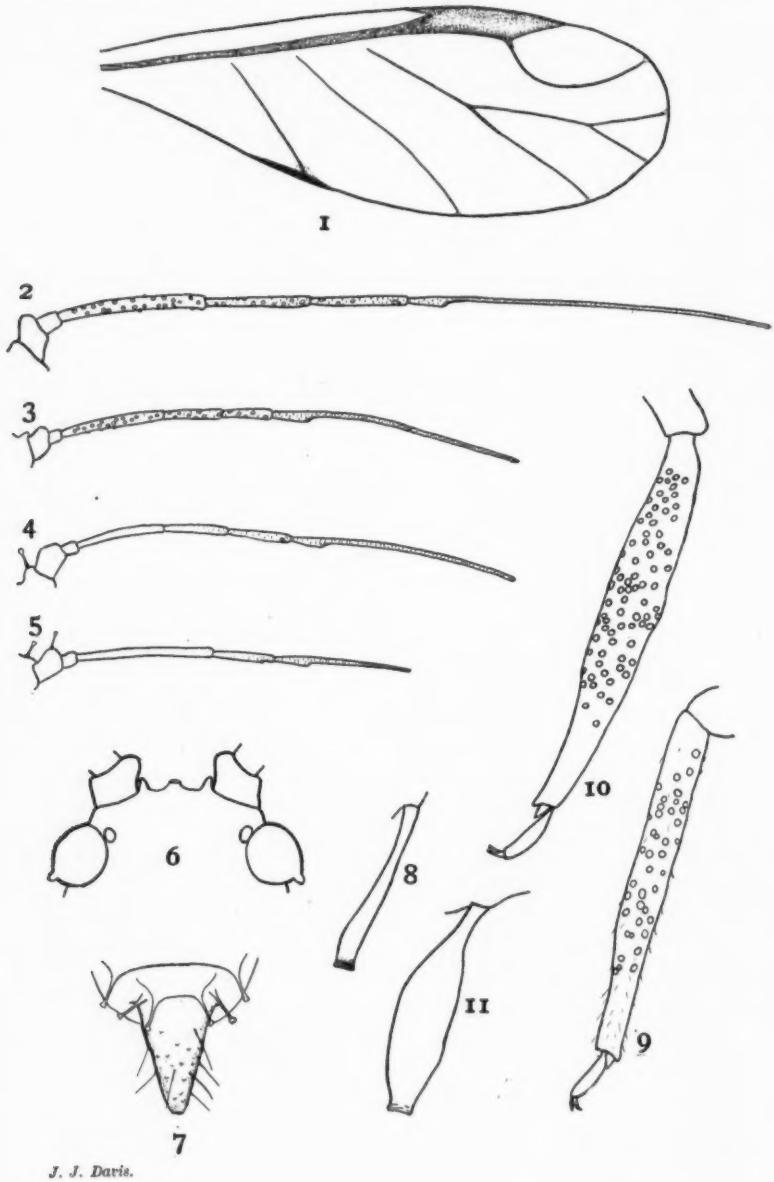
Figure 10, hind tibia of wingless oviparous ♀; 11, cornicle of wingless vivivarous ♀; 12, fore wing; 13, style; 14, antenna of winged ♂; 15, of winged viviparous ♀; 16, of wingless oviparous ♀; 17, of wingless viviparous ♀; 18, head of winged viviparous ♀.

Callipterus trifolii Mon.—Plate XXII, figs. 19–21; Plate XXIII, 28–33.

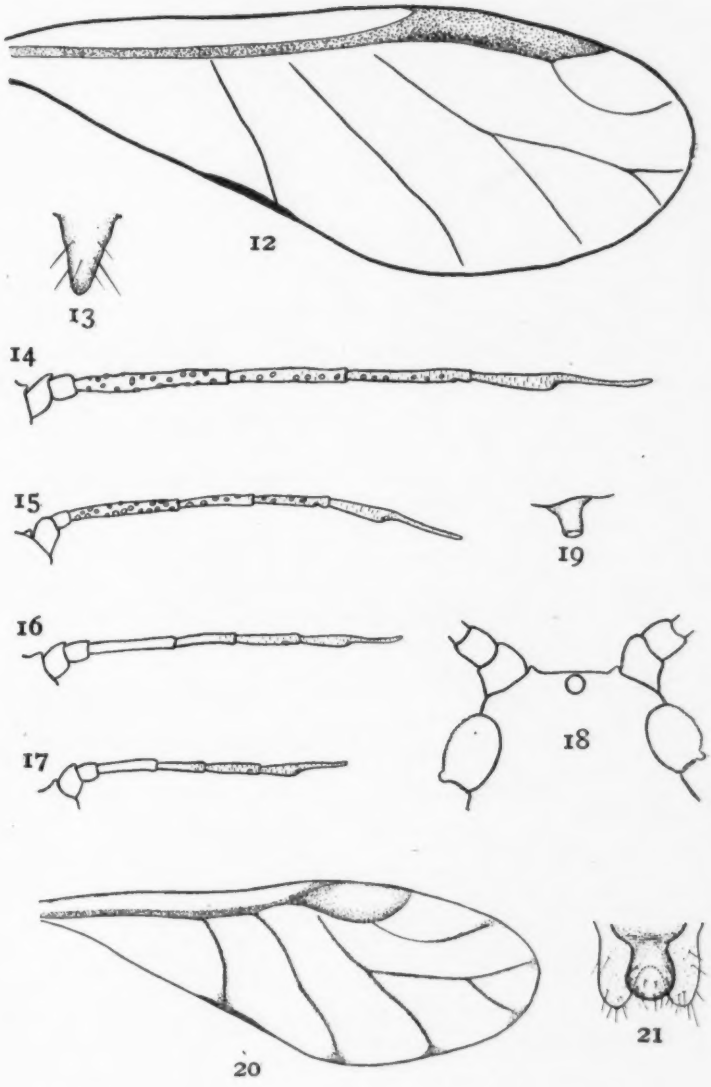
Figure 19, cornicle of winged viviparous ♀; 20, fore wing; 21, style of winged viviparous ♀; 28, head of winged viviparous ♀; 29, antenna of winged viviparous ♀; 30, of wingless viviparous ♀; 31, of winged ♂; 32, of wingless oviparous ♀; 33, hind tibia of wingless oviparous ♀.

Aphis bakeri Cowen.—Plate XXIII, figs. 22–27.

Figure 22, fore wing; 23, head of winged viviparous ♀; 24, antenna of winged viviparous ♀; 25, of wingless viviparous ♀; 26, cornicle of winged viviparous ♀; 27, style of winged viviparous ♀.



J. J. Davis.



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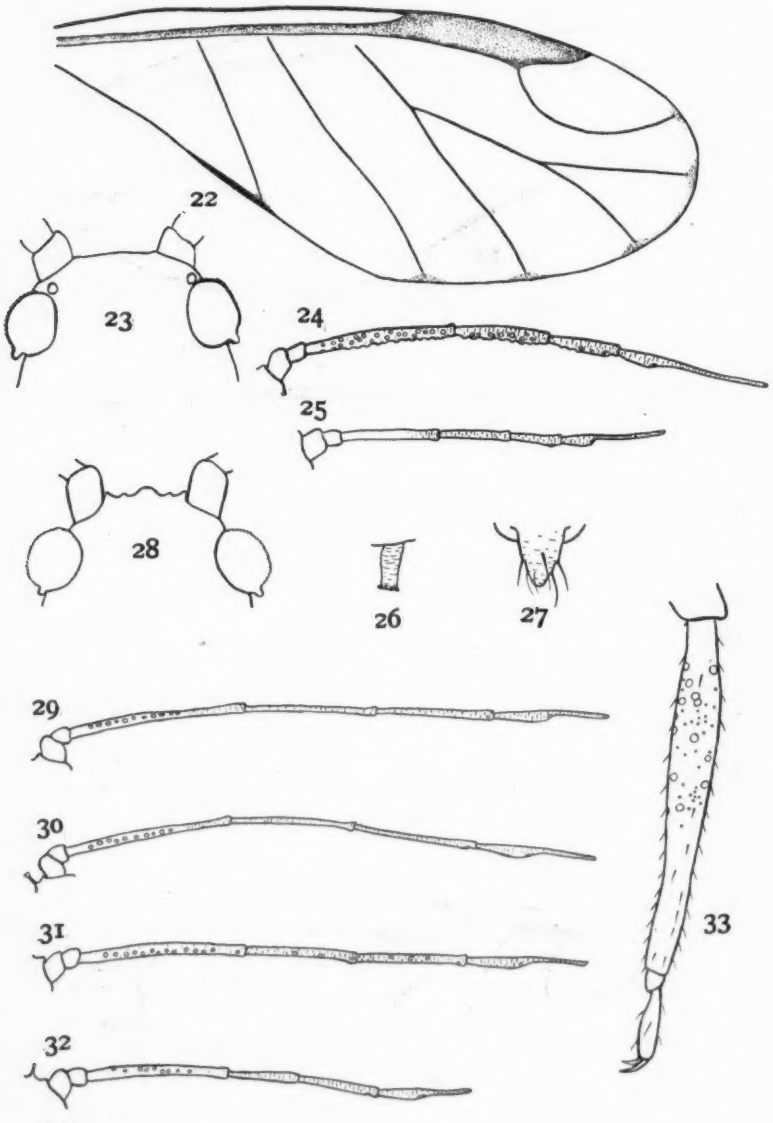

J. J. Davis,

MUSCLE ATTACHMENT IN INSECTS.*

WILLIAM A. RILEY.

As a rule, writers on insect histology have been content to state that the muscles are attached to the body-wall, without attempting to explain the mode of attachment. Within the past few years considerable attention has been paid to this phase of the subject, but there is little agreement in the views expressed and the question can by no means be regarded as closed. For some time, in connection with general work, the writer has paid special attention to this question, intending to make a study of the conditions in a wide series of insects. The comprehensive work of Snethlage, '05, and his exhaustive review of the literature, have rendered superfluous extended publication of these results but it is desired to call attention here to some features of the subject which have not been emphasized, and especially to the striking conditions to be found in the nymphs of Anax, a dragon-fly.

Theoretically, considering the structure of the body-wall of an arthropod, the muscles may be attached in any one of the several different ways. The fibers may be fastened directly to the cuticula or they may be attached through the intermediary of the hypodermal cells.

In the first instance, either the muscle fibers would force their way between the hypodermal cells in order to reach the cuticula (text-figure *A*), or their fibrils would pass directly through the hypodermal cell-body, (text-figure *B*).

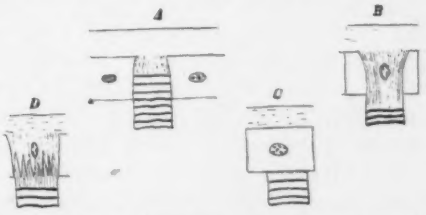

Fig. 6. Diagrams showing four possible methods of attachment of muscle fibers in arthropods. For explanation see text.

In case the attachment be through the intermediary of the hypodermal cells, the fibers might abut against the basement

*Contribution from the Entomological Laboratory of Cornell University.

membrane, being soldered to the cell, as in *C*, of the text-figure. Or, as in *D*, the union might be due to the interlacing or dovetailing of the muscle fibrils with those of the hypodermal cells.

Apparently clear illustrations of the direct passage of the muscle fibrils through the hypodermis are afforded by sections of the nymph of Chortophaga viridifasciata, an Acridid. Such a section is represented in the photomicrograph, plate XXIV, fig. 1, and from the study of such sections alone there would be little question that the muscle fibrils are attached directly to the cuticula. Unless they have themselves become fibrilloid there is left at the point of muscle attachment but little trace of the hypodermal cells. They are clearly indicated by their nuclei, which are larger than those of the muscle and in which the distribution of the chromatin is also different. Moreover, their limits are shown by the very definite, dark-brown pigment granules similar to those found in the hypodermal cells of other regions.

Snethlage has pointed out that it is easy to see how an oblique section through the muscle and the overlying hypodermis would present, in some cases, the appearance shown in *C*, and thus lead to a misinterpretation. On the other hand, if an axial section presents the appearance shown in the photograph, it becomes a question of determining whether the prominent fibrils in the hypodermal cells are muscle fibrils, pushing through the cell as in *B*, or whether they are what Maziarski, '03, has aptly denominated tonomitomes, i. e., filaments of protoplasm differentiated in the epithelial cell itself, as a result of mechanical stimulus.

It was when examining some sections of the nymph of Anax, prepared by Dr. Needham for the study of wing development, that I had my attention attracted to striking evidence in favor of the view that muscle attachment in insects is through the intermediary of the hypodermal cells, as has been maintained by Weismann, '63, Leydig, '85, Bertkau, '85, Duboscq, '98, and others.

As may be seen from figure 2, the hypodermal cells in the region of the muscle attachment are very elongate and narrow, measuring about 50μ in length and 5μ in width. They are sharply differentiated by the haematoxylin-eosin stain, being much bluer than the attached muscles. Their nuclei are also distinct from those of the muscle fibers. The cells are feebly

longitudinally striate but their fibrils appear finer than those of the muscle and there is no clear evidence of direct continuity of the two. On the contrary, I believe that there occurs a splicing or fusion of the two types of fibrils, the basement membrane being lacking at the point of contact.

The sections first studied were of alcoholic material, cut at 10μ and stained in haematoxylin and eosin. In order to make a more careful study material was fixed in Flemming's and in Gilson's fluids, sectioned at 2-3μ and stained in iron haematoxylin. The appearance was then very similar to that presented by the above mentioned sections of Chortophaga.

As may be seen from figure 3, the striae are much more prominent and the muscle fibrils, as in Chortophaga, are apparently continued through the body of the hypodermal cells to attach directly to the cuticula. This appearance is greatly emphasized in the sections in which, as in figure 4, the cuticular layer has been torn away. Then the distal ends of the cells present a frayed-out appearance, due to the projecting fibrils.

At the Chicago meeting of the American Association I exhibited lantern slides from these preparations and, emphasizing as they do, the appearances found by Snethlage in a large series of insects, I believed that they represented direct attachment of the muscle fibers to the cuticula. Studies of developing muscle in the postembryonic stages, and renewed examinations of the conditions in Anax and other forms have forced me to return to my first interpretation of the conditions.

Most instructive were sections through the developing wing-muscles of Anax such as represented by figures 5 and 6. In these photographs there is to be seen an apodeme-like invagination of the body-wall, surrounded by its hypodermal cells. Near its apex these cells become suddenly greatly elongated, their nuclei become fusiform, and placed at the bases of the cells, while prominent longitudinal striae appear within them. The basement membrane is deflected to enclose the muscle fibers and, in fact, the whole appearance seems to support Snethlage's contention that the muscle fibers are hypodermal in origin, merely prolongations of the epithelial cells.

From my studies I am, however, unable to accept this view that the muscle fibers of the arthropods are structurally prolongations of the chitinogenous cells. Snethlage bases his theory on a study of the development of the musculature of the nauplii of

Artemia salina, but I do not believe that even for this species his evidence is conclusive, and I do not find any satisfactory evidence to overthrow the almost unanimous testimony of careful workers in favor of the mesodermal origin of this tissue in insects. Snethlage objects that the concept of the inpushing of a special, independently originating tissue at definite points in the body-wall savors of the theory of "praestabilierten Harmonie" but this objection would no more hold than in the case of nerve endings, or others that might be cited. Moreover, he overlooks the fact that however the muscle *originated*, his own objection would still hold when its *insertion* is considered.

An important point to be considered in a study of the method of muscle attachment is the remarkable differentiation of the hypodermal cells in the region of the attachment. In many cases as in Anax, they become very greatly elongate and fibrilloid, as compared with the immediately neighboring cells of the body-wall. This is especially clearly seen in figure 5. If the muscles are attached directly to the cuticula, why should there be this great elongation of the epithelium? If, on the other hand, the attachment is through the intermediary of the hypodermal cells, it is just such a change which we might expect.

Van Rees, '89, found that in the thorax of the pupa of Musca the muscle tendons are developed in this manner, as prolongations of the hypodermal cells which grow inward to meet the developing muscle. Similar studies by Berlese, '01, and by Silvestri, '03, lead them to declare emphatically in favor of the view that the attachment of the muscle is through the intermediary of the hypodermal cells.

Hecht, '99, has called attention to the remarkable appearance of the muscular insertions in the myrmicophilous dipterous larva, Microdon. In this form the fibrillated appearance can be traced not only through the hypodermal cells but through the total thickness of the greatly developed secondary cuticula, spreading out fan-like under the primary cuticula. Through the kindness of E. L. Jenne, I have had the opportunity of examining a number of sections of these larvae and find the fibrils very prominently developed but by no means as clearly muscular as Hecht's figures would indicate. A very similar condition is to be found in sections of Muscid larvae, though in the ones which I studied the arrangement of the fibrils was in the form of a cone with its base entad, rather than as in Microdon. In none of the cases were the

conditions such as to preclude the purely hypodermal origin of these fibrils.

A number of writers, notably Tower, '06, have called attention to the fact that when the cuticula loosens, its attachment persists longer at the point of attachment of the muscles than elsewhere and they have thought to see in this proof of the view that the muscles were attached directly to the cuticula. Such evidence is by no means conclusive for as in the instances mentioned above, this condition might very well prevail in either case.

The whole problem is one of great interest and, as stated at the outset, can be by no means regarded as closed. I cannot believe with Sinety that we have the anomaly of both methods occurring within different species of even the same family of insects. The evidence very strongly supports Maziarski's view that the so-called muscular fibrils passing through the hypodermal cells are in reality modifications of its own protoplasm,—true tonomitomes.

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EXPLANATION OF PLATE XXIV.

Fig. 1. Muscle attachment in the nymph of Chortophaga viridifasciata, an Acridid.

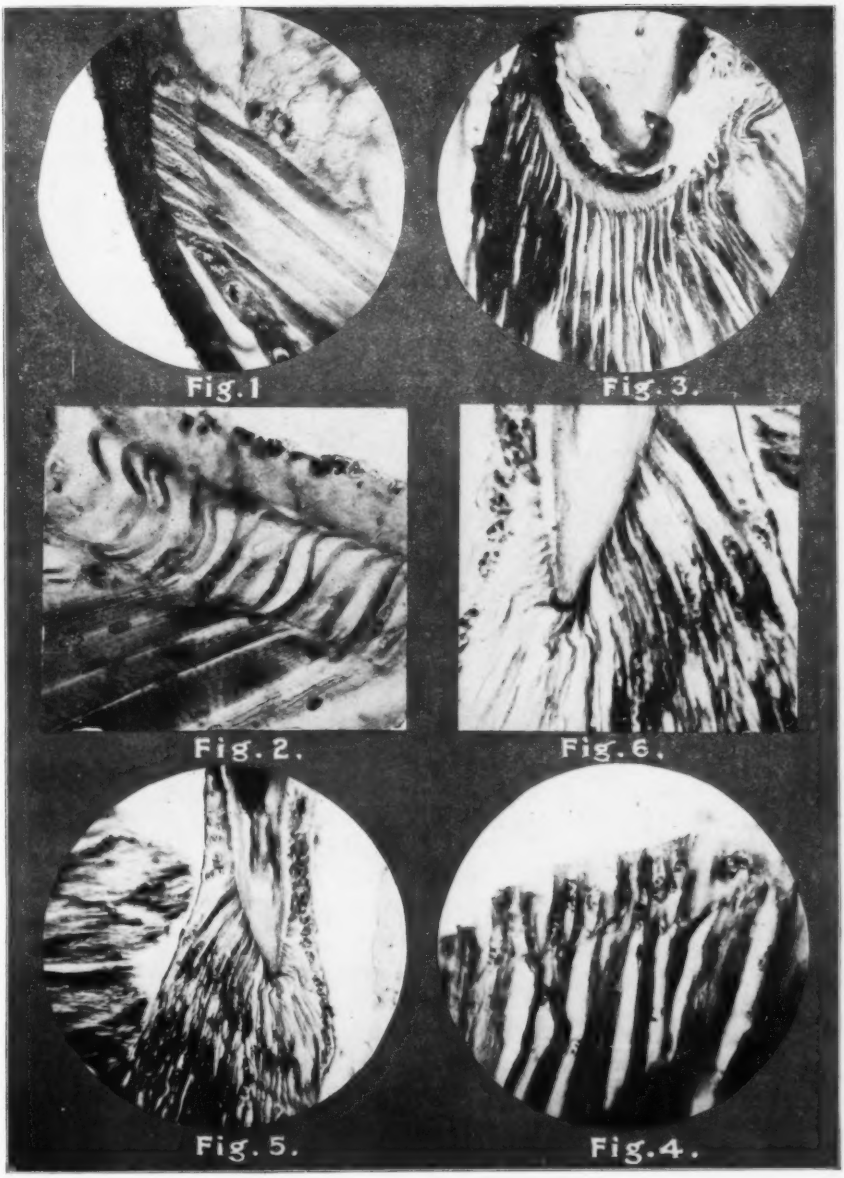
Fig. 2. A portion of the body-wall of a nymph of Anax, showing the greatly elongated hypodermal cells at the point of attachment of the muscles.

Fig. 3. Muscle attachment in another individual of Anax.

Fig. 4. A preparation of Anax from which the cuticula has been broken away, showing the frayed-out ends of the hypodermal cells.

Fig. 5. An apodeme of a nymph of Anax, showing the greatly elongated hypodermal cells at the point of attachment of the developing muscle.

Fig. 6. The same, enlarged



W. A. Riley.

CRITICAL NOTES ON THE CLASSIFICATION OF THE CORDULIINAE (Odonata).

By James G. Needham.

Ten years ago I studied such of the dragonflies of the subfamily Corduliinae as I found accessible in this country. I made exchanges, and visited the principal museums, and was able to get acquainted with about three fourths of the known genera. I studied them especially with reference to their wings, and drew up a sketch of the principal lines of their specialization as evidenced by the wing veins. This mere outline was later included in my "Genealogic Study of Dragonfly Wing Venation".[1] There remained a number of genera of which I had no knowledge, save such as might be gained from brief descriptions, that noticed but few venational characters, and these often the least important ones. Even at so recent a date, there were no good figures of dragonfly venation published, save only a few of fossil species; and the cuts illustrating dragonfly venation in the text books were for the most part the worst of caricatures, as in some of them they still continue to be.[2]

In my first Adirondack report,[3] I attempted to arrange the North American Genera in natural order, basing the system therein used chiefly on wing venation and on nymphal characters. When characters so diverse in kind give concurrent evidence of relationships, one can arrange a group with reasonable assurance. But in my characterization of groups in that report I used beside the more fundamental characters sometimes more trivial ones, applicable only to North American genera, my object being merely to facilitate the recognition of the different members of our local fauna.

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1. Proc. U. S. Nat. Mus. Vol. 26, pp. 739–741, 1903.

2. Witness the dragonfly venation figure in Kellogg's American Insects (fig. 121, p. 89.) This is just a little better than that of stonefly venation (fig. 109) on page 73. These figures are not to be regarded bad because they are crude diagrams, but because they are false and misleading. In the diagram, for example, of the dragonfly wing (fig. 121), the arculus, the vein labelled 7 at its base and the anal veins are all shown in relations with other parts that they never bear to these parts in any living dragonfly. This is a copied figure, to be sure, and the original figures of American Insects are not subject to this criticism.

3. Bull. 47, N. Y. State Museum.

Hence, although I was able, through the tracing of lines of specialization, to indicate natural groups, I made no attempt to locate all the genera of the world in these groups, nor to set their precise boundaries.

The recent magnificent work of Monsieur R. Martin on the Corduliinae of the great de Selys collection[4] supplies excellent figures of the venation of every known genus (as well as figures of the genitalia of most of the species) and is a boon to every worker on the Odonata. Naturally, the system of classification used in this work is largely that of de Selys: but M. Martin has furnished in his illustrations and in his key abundant data for a more modern arrangement of the group. As I have had opportunity, I have been studying this data from time to time, comparing the figures with my own photographs, and drawing up a key to the genera of the world as a means of setting forth a more natural arrangement of the entire group.

I had these keys before me when Mr. Williamson's recent "Revision of the Classification[5] of the Corduliinae" came to hand, and I have studied this paper with great interest and pleasure. Williamson's arrangement of the genera is a vast improvement over the pioneer arrangement of de Selys; and the improvement grows out of better discernment as to what are the fundamental venational characters. De Selys' primary division of the group, (made, it must not be forgotten, at a time when these characters were little understood), was based upon the presence or absence of crossveins in the supertriangle. These crossveins are always weak and functionally unimportant, and if sometimes fairly constant, this is just the sort of character most likely to prove misleading at critical points. It was only by too close adherence to this criterion that Aeschnosoma, for example, could be severed from its obvious allies, Somatochlora, etc., and immolated among the coarse Macromians. Williamson abandons the use of such characters (perhaps a little too completely), and wisely bases his arrangement on the disposition of the principal veins of the wing. He arranges the genera in five groups "of approximately co-ordinate rank", and demonstrates that the members of each group possess numerous marks of affinity. But he leaves three genera *incertae sedis* (the three Corduline genera with triangles of the

4. Collections Zoologiques du Baron Edm. de Selys Longchamps; Catalogue Systematique et Descriptif. Fascicle XVII. Brussels, 1906.

5. Entom. News. Vol. 19, pp. 428–431, 1908.

fore wings four sided) out in the cold, and, quite apart from the theoretical improbability of more than two co-ordinate groups in any evolutionary series, I think he has not discriminated sufficiently as to the value of the different characters to be found in the disposition of principal veins.

Hence it will not be amiss to present in this paper some further studies on the venation of the group and their bearings on the classification.

What are the fundamental venational characters in the Corduliinae? Undoubtedly they are those connected with the differentiation between fore and hind wings. For fore and hind wing were originally alike. In each of the larger subfamilies of Odonata may be found one or more weak and dimunitive forms that have fore and hind wings much alike still. I copy Martin's figure

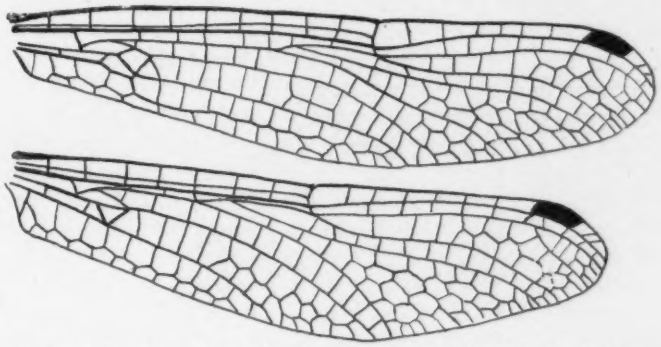

Fig. 7. The wings of Cordulephya pygmaea Selys (after Martin).

of the little Australian species, Cordulephya pygmaea Selys, in illustration of this for the Corduliinae. Here the two wings correspond with remarkable closeness, and may be compared through out, almost cell for cell. And, as were befitting in a form so generalized, the "triangle" of the forewing has not become triangular. Elsewhere[6] I have shown how the triangle is formed by the approximation of the anterior ends of two crossveins upon a neighboring vein. This process is complete in the hind wing of Cordulephya.

6. Amer. Nat. Vol. 32. pp. 903–911, 1898, and Proc. U. S. Nat. Mus., Vol. 26, p. 717, 1903.

Obviously differences in the approximation of these cross-veins are differences of degree only. Such differences are not fundamental enough for primary divisions of a subfamily. It would be hard to find three genera with less affinity than the three having four sided triangles in this subfamily. Williamson has indicated some diametrically opposite developments in Neophya and Cordulephya, and I have shown[7] that the four sided triangle of Pentathemis is not primitive, but secondarily derived from a three-sided one, and is an extreme case of specialization.

With the exception of Cordulephya, all Corduline genera have fore and hind wings of very different form. This differentiation has been brought about by a number of minor shifts of parts, which I have pointed out in the paper last cited, and *chiefly* by the broadening of the hind angle of the hind wing and the development of an anal loop for its support. This development has followed two distinct methods:

I. An anal loop of compact Cordulegasterine form (fig. 8, *d*, *l*), externally delimited by a stout straight basal segment of the vein Cu2, has interposed itself squarely between the triangle and the hind angle; and in consequence there is slight tendency for the triangle to recede to the level of the arculus. This is the group MACROMIINAE, which I characterized in 1903. It is Williamson's group V with Macromidia added. It ought to be recognizable by the characters I stated even though its constituent genera were not all named. In my judgment it is co-ordinate with all the other Corduliinae s. str. put together. If any one think it insufficiently defined, let him distinguish between the long recognized Libellulinae and Corduliinae s. str. with equal definiteness.

II. Anal loop tending from the first to be elongate and narrow and to extend itself outward along the cubital vein, with concurrent recession of the triangle to the level of the arculus (fig. 8, *a*). This is the group CORDULIINAE s. str.

These tendencies are least marked in the aberrant genera Gomphomacromia (fig. 8, *b*) and Idyonyx, in which the anal loop has remained short but even in these the form of the anal loop and its relations to the basal portion of vein Cu2, are distinct from the Macromian type: In Idionyx and in all except Gomphomacromia the bisector of the loop, dividing its two parallel rows of cells

7. Proc. U. S. Nat. Mus. Vol. 26, p. 718, footnote.

longitudinally, is established; there is nothing like a bisector in the Macromian line.

The anal loop, although just beginning to be recognized and used in the systematic study of the Odonata, has undoubtedly played a role of first importance in the evolution of the wings of the Corduliinae. Within the restricted group just defined the tip of the anal loop has developed in two divergent ways:

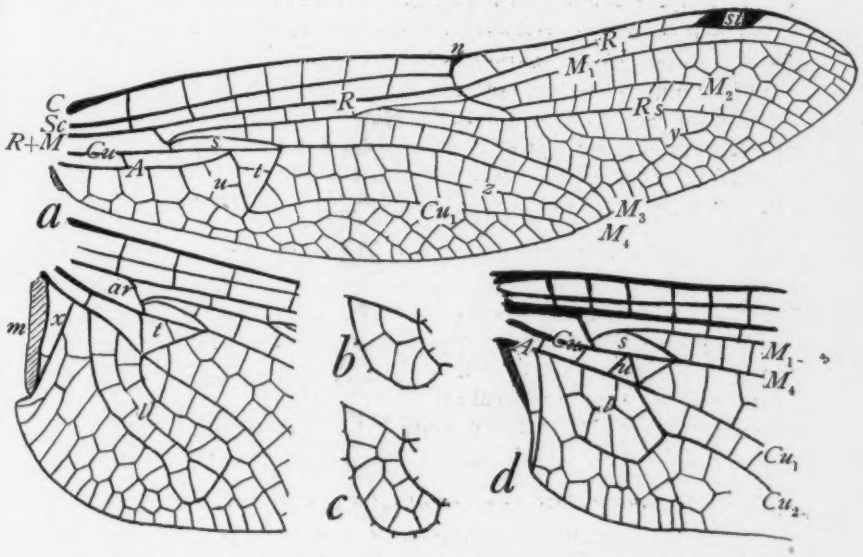

Fig. 8. Typical structures of Corduline wings: (a) the wings of Tetragoneuria cynosura Say; (b) the anal loop of Gomphomacromia paradoxa; (C) the same of Syncordulia gracilis; (d) base of hind wing of Macromia. Veins: (c), costa; (Sc) subcosta; (R) radius; (M) media; (Cu) cubitus; (A) anal; (Rs) radial sector; other branches numbered from front to rear. Other parts, (ar) arculus; (n) nodus; (st) stigma; (s) supertriangle; (t) triangle; (u) subtriangle; (m) membranule; (x) anal triangle of the male; (l) anal loop; (y) radial supplement; (z) median supplement.

(1) It has extended itself outward parallel to the vein Cu1 in a bilaterally symmetrical point, and the tendency of the triangle to be concurrently retracted to the level of the arculus has been least where the elongating loop has most closely paralleled vein Cu1. (Idomacromia, etc.) This tendency may be said to characterize in a general way Williamson's groups III and IV, with Neophya added to group IV. The Triangle has reached the level

of the arculus only in Neophya and certain species of Neocordulia, and in the latter, the anal loop is truncated on the tip and shows a very slight apical widening.

(2) On the other hand, the anal loop tends elsewhere to become unsymmetrical on its broadly truncated apical end, and to develop a long posterior angle toward the hind margin of the wing (fig. 8, *a*, *l*). This is the most salient characteristic of Williamson's groups I and II, with Pentathemis added to group II.

In endeavoring to trace the further cleavage of these groups, I have deemed these characters of most importance: (1) the primary differentiation between fore and hind wing; (2) the manner of development of an anal loop; (3) the form of the special braces formed at arculus, triangle and stigma, and (4) the mutual adjustments of the principal branches of veins in the outer field of the wing; and I have used such characters as the presence or absence of crossveins, only when characters like those above mentioned seemed to be wanting. I have largely copied Martin's arrangement of the genera of Williamson's group I. The minor divisions of the key need to be checked by the study of other characters. The venation of the Odonata is at the present time receiving more than its share of attention. There is great need of critical comparative study of other organs, and there is especial need of more knowledge of the immature stages.

KEY TO THE GENERA OF THE CORDULIINAE, s. lat., OF THE WORLD.

(Based on venational characters.)

a) Anal loop compact, little longer than broad, without bisector, delimited distally by a short straight basal segment of vein Cu2; triangle of the forewing transversely elongate, and that of the hind wing never retracted toward the arculus. SUB-FAMILY MACROMIINAE.

b) Veins M3 and M4 straight or regularly arcuate behind the nodus.

c) Median (or basal) space traversed by crossveins; alternate antenodals often hypertrophied or thickened..... **Synthemis**

cc) Median space destitute of crossveins; anal loop considerably longer (in the axis of the wing) than broad..... **Macromidia**

bb) Veins M3 and M4 distinctly undulate behind the nodus in both wings.

c) Triangles and subtriangles of the forewings traversed by crossveins.

d) Vein Cu where it bounds the subtriangle of the forewing on the proximal side strong and straight..... **Azuma**

dd) Vein Cu where it bounds the subtriangle of the forewing, weak and angulate among the cells..... **Epophthalmia**

cc) Triangles and subtriangles of the forewings free from crossveins.

d) Triangle of the forewings followed by two rows of cells. . **Macromia**

dd) Triangle of the forewings followed by a single row of cells..... **Phyllomacronia**

aa) Anal loop when present of elongate form bounded distally by a curving basal segment of vein Cu2, and traversed lengthwise by a more or less distinct bisector; two postanal cells in the fore-wing. SUB-FAMILY CORDULIINAE S. STR.

b) With fore and hind wings closely similar; no anal loop.... **Cordulephya**

bb) Hind wings broader than the fore and with well developed anal loop.

c) Anal loop not widened at the distal end, nor with an unsymmetrical prolongation of the apex toward the hind margin. Triangle not retracted to the level of the arculus.*

d) Triangle of the forewing four sided; that of the hind wing retracted to the arculus, and the hind angle of the wing greatly expanded ..... **Neophya**

dd) Triangle of the forewing normal; that of the hind wing not retracted to the arculus.

e) Anal vein extends almost or quite directly to the hind angle of the triangle in the forewing, and the subtriangle is elongate and four sided; veins M1–3 and M4 descend the arculus its entire length, and are fused for an equal distance beyond it in both wings; post-nodal space (space between the nodus and the stigma) but half as long as the antenodal..... **Idionyx**

ee) Anal vein reaches the triangle after being twice strongly deflected around the angles or the subtriangle; subtriangle three sided; postnodal space two thirds as long as the antenodal.

f) Veins M3 and M4 parallel at their distal ends: the bisector of the anal loop divides the basal part unequally, some of the cells on the side of it next the triangle being again divided.

g) With well developed median supplement in both fore and hind wing..... **Idomacromia**

gg) With no median supplement developed in either wing **Nesocordulia**

ff) Veins M3 and M4 divergent to the outer wing margin anal loop consisting of but two rows of cells about equally divided by its bisector.

g) Anal loop short, and lacking a distinct bisector..... **Gomphomacromia**

gg) Anal loop longer, and with distinct bisector.

h) Veins M3 and M4 of the forewing strongly divergent at tips; bisector of the anal loop (fig. 8, *c*) weak and angulate between the cells..... **Syncordulia**

hh) Veins M3 and M4 of the forewing but slightly divergent at the wing margin: bisector of the anal loop better beveloped, usually but little angulated: stigma at least three times as long as wide.

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* Except in Neophya which is specialized so independently it will cause no confusion, and in one or two species of Neocordulia, which are truly synthetic forms, but in which the anal loop is rather more squarely truncated on the ends than in any of the others. N. volxemi Sel., in my opinion, agrees in all essential characters with typical Neocordulias, and ought not to be removed to Gomphomacromia, with which it does not at all agree in such important matters as the form and relations of the triangles the form of the anal loop, the conformation at the arculus, or the venation about the stigma.

The number of cell rows in a given wing area, like that beyond the triangle, when variable, is always determined merely by the presence or absence of weak crossveins.

Neophya is remarkable for the contrast between the two wings in point of specialization. The forewing has a triangle of the most primitive sort, while the hind wing exhibits the maximum of broadening of the hind angle together with complete retraction of the triangle to the arculus.

i) Veins M1–3 and M4 separate at their departure from the arculus in the forewing ..... **Oxygastra**
ii) Veins M1–3 and M4 fused a little way beyond the arculus in the forewing ..... **Neocordulia**
cc) Anal loop widened at its distal end and truncated more or less unsymmetrical, the hind angle being produced sensibly toward the adjacent wing margin. Triangle of the hind wing always retracted as far as the level of the arculus.
d) Veins M1–3 and M4 fused beyond their departure from the arculus; cells along the middle of the anal loop divided by the bisector very unequally, those lying on the cubital side being much narrower. Vein M3 distinctly undulate behind the nodus; median supplement distinctly developed in the fore wing; supertriangle with crossveins.
e) Veins M1–3 and M4 fused into a straight stalk at their departure from the arculus..... **Pentathemis**
ee) Veins M1–3 and M4 strongly arched forward at their departure from the arculus.
f) With more than 10 antenodal crossveins: superior appendages of the male forcipate..... **Aeschnosoma**
ff) With 10 or fewer antenodal crossveins; appendages of the male not forcipate..... **Libellulosoma**
dd) Veins M1–3 and M4 not fused in the forewing at their departure from the arculus: vein M3 straight or regularly arcuate behind the nodus. Supertriangle free from crossveins.
e) Veins M4 and Cu1 divergent to the wing margin.
f) Bisector of the anal loop furcate at the slightly unsymmetrical widening of distal end..... **Platycodulia**
ff) Bisector of the anal loop running into the posterior prolongation of the very unsymmetrically widened distal end ..... **Neurocordulia**
ee) Veins M4 and Cu1 not divergent to the wing margin, usually slightly convergent.
f) Hind angle of hind wing rounded in the male: vein M4 more or less broken..... **Hemicordulia**
ff) Hind wings angulate in the male.
g) 2nd cubito-anal crossvein present in the hind wing (therefore, the subtriangle present).
h) wings spotted..... **Epitheca**
hh) Wings clear..... **Somatochlora**
gg) 2nd cubito-anal crossvein (and therefore also the subtriangle) absent in the hind wing.
h) Triangle of the forewing traversed by a crossvein.
i) Wings spotted with brown.
j) Triangle of the hind wing traversed by a crossvein, **Epicordulia**
jj) Triangle of the hind wing open.
k) Antenodals of the hind wing 6..... **Helocordulia**
kk) Antenodals of the hind wing 4 or 5.. **Tetragoneuria**
ii) Wings clear.
j) Antenodals about equal in number to the postnodals in the forewing ..... **Cordulia**
jj) Antenodals decidedly more numerous than the postnodals in the forewing, **Procordulia and Paracordulia**
hh) Triangle of the forewing open ..... **Dorocordulia**

A KEY TO THE SPECIES OF PROSPALTELLA, WITH TABLE OF HOSTS, AND DESCRIPTIONS OF FOUR NEW SPECIES.

By L. O. Howard.

The genus Prospalta, of the subfamily Aphelininae, was founded by the writer in 1894 (Insect Life, Vol. VII, p. 6) for P. murtfeldtii How., a parasite of Aspidiotus uvae and other Diaspine scales. Since that time other species have been described by Zehntner, Masi, Girault and the writer. Ashmead, noticing that the generic Prospalta was preoccupied in Lepidoptera (Walker, 1857,) proposed as a substitute the name Prospaltella in Proceedings Entomological Society of Washington, Vol. VI, p. 126, 1904. The descriptions are so widely separated in different publications that, for the sake of convenience in determination work, the following synoptical key has been drawn up. Masi, in Vol. III, of his important Contribuzioni all Conoscenza dei Calcididi Italiani (Portici, 1908), gives it as his opinion that P. tristis Zehnt., belongs rather to the genus Coccophagus; but the writer fortunately possesses cotypes of this species sent him by Doctor Zehntner, and is able to state that the species was correctly placed by its describer.

Genus **Prospaltella** Ashmead, 1904.

Prospalta Howard, 1894 (preoccupied).

1. Forewing with a trace of a very short pointed marginal vein, its lower margin curving strongly towards base of wing and then outwards to form outer border of stigmal ..... **similis** Masi
Forewing with upper margin of stigmal vein reaching wing margin at a point very slightly distad of its slightly reentering curve, thus faintly indicating a post marginal 2
Forewing without the slightest tendency towards a post marginal 3
2. Forewings nearly hyaline, sometimes very faintly dusky below marginal vein, occiput yellow ..... **koebelei** n. sp.
Forewing with a very pronounced broad dark band below marginal vein, occiput with a broad transverse black band ..... **quercicola** n. sp.
3. Upper margin of stigmal vein reaching wing margin by a gradual proximal curve 4
Marginal vein squarely truncate, stigmal proceeding from anal portion of truncation ..... **maculata** How.
Marginal vein convexly truncate, upper margin of stigmal nearly parallel with wing margin 5
4. Flagellum of antennae distinctly clavate 6
Flagellum nearly filiform 7
5. Wings nearly hyaline, only very faintly infuscated; legs uniformly pallid; antennae concolorous ..... **tristis** Zehnt.
Wings with a pronounced infuscated patch below marginal vein; legs and antennae banded 9
Wings nearly uniformly infuscated, legs banded, flagellum dark with slightly lighter tip to club ..... **fuscipennis** Girault.

6. Wings with a broad dusky band below marginal vein; abdomen yellow with brown transverse band just caudad of middle.....**citrella** n. sp.
Wings hyaline.....8
7. Joints 1 and 2 of funicle distinctly shorter than joint 3.....**berlesei** How.
Joints 1, 2 and 3 of funicle subequal in length.....**conjugatus** Masi.
8. Abdomen dusky, remainder of body yellow with occasional darker markings.....**aurantii** How.
Head and thorax dark brown, nearly black; mesoscutellum lighter and abdomen with light patch in center above.....**brunnea** n. sp.
9. Hindwings with two rows of discal cilia.....**murtfeldtii** How.
Disc of hindwings rather densely ciliate.....**fasciativentris** Girault.

New Species.

Prospaltella quercicola n. sp. ♀.

Female.—Length, 0.73 mm.; expanse, 1.53 mm.; greatest width of forewing, 0.26 mm.; antennae subfiliform; all funicle and club joints subequal in length and width; eyes very faintly hairy; forewing with the upper margin of stigmal vein reaching wing margin at a point very slightly distad of its slightly reentering curve, thus faintly indicating a postmarginal vein; abdomen and metanotum piceous; pronotum and front of mesoscutum, as well as propleura and mesopleura, also piceous; vertex of head bright lemon yellow; ocelli crimson; occiput black; all legs pallid except hind femora and trochanters, which are dark brown; antennae pallid yellow except terminal joint of club, which is fuscous; hind portion of mesoscutum, including all of the parapsides, lemon yellow; mesoscutellum nearly white; wings with a broad, well-defined dark fuscous band extending entirely across the wing from the submarginal and stigmal veins.

U. S. N. M. type No. 12163. Described from 14 female specimens reared by R. S. Woglum, of the Bureau of Entomology, U. S. Dept. Agric., April, 1908, from Aleyrodes gelatinosus Cock'll, on Oak, Los Angeles, Cal.

Prospaltella koebelei n. sp. ♀.

Female.—Length, 0.65 mm.; expanse, 1.65 mm.; greatest width of forewings, 0.26 mm.; antennae long, almost filiform; joint 1 of funicle slightly shorter than pedicel and only half as long as joint 2; joints 2 and 3 and basal joint of club subequal in length, the basal end of the club being slightly wider, joint 2 of club a little more than half as long as joint 1, terminal joint slightly longer; stigmal vein of forewing resembling that of the preceding species. Abdomen and pronotum brown; head entirely yellow; ocelli red; meso- and meta-notum dark yellow; legs pallid except hind femora, which are dusky; antennae yellow, pedicel and last two funicle joints darker than the rest; wings nearly hyaline, the disc of the forewing below marginal vein very faintly and indefinitely infuscated.

U. S. N. M. Type No. 12162. Described from 21 female specimens, reared by Albert Koebele, from Aspidiotus longispina Morg., Hawaii (Koebele's No. 1122).

Prospaltella citrella n. sp.

Female.—Length, 0.72 mm.; expanse 1.7 mm.; greatest width of forewing 0.245 mm. Antennae distinctly clavate, somewhat flattened; funicle joint 1 shorter than 2 and than 3; stigmal vein as with aurantii; forewings with a broad infuscate band extending from marginal vein to hinder border of wing. General color bright lemon-yellow; vertex deeper yellow, tending towards orange; eyes black; ocelli crimson; antennae yellow, terminal joint of club darker; all legs pallid; abdomen with a broad, transverse, brown band covering two segments caudad of middle.

Type No. 12164, U. S. N. M. Described from three female specimens reared by Dr. A. W. Morrill, Orlando, Fla., from Aleyrodes coronatus.

There is also in the collection of the Bureau of Entomology of the Department of Agriculture one specimen of what seems with little doubt to be this species, reared by Albert Koebele from males of a Kermes on Quercus undulata at Nogales, Ariz., May 3, 1897. On the same slide are several specimens of an Amitus (Proctotrypidae), and also several shriveled males of an Aphelinine which may possibly belong to the species above described, but their condition will not warrant a description.

Prospaltella brunnea, n. sp. ♀.

Female.—Length 0.85 mm.; expanse 1.7 mm.; greatest width of forewings 0.25 mm.; antennae distinctly clavate; first funicle joint subequal in length to joint 2 and to 3; wings hyaline; mesoscutum and scutellum with delicate hexagonal sculpturing. General color dark brown; mesoscutellum somewhat lighter; center of abdomen above occupied by a large white spot; antennae faintly yellowish; all legs pallid.

Type No. 12165, U. S. N. M. Described from one female specimen reared from Aleyrodes sp. (undescribed) on a climbing vine, collected at Bayamon, Porto Rico, January, 1899, by A. Busck. (Bureau of Entomology, No. 8423.)

SPECIES PREVIOUSLY DESCRIBED.

aurantii How.—♀—U. S., China, Australia, Europe.

Coccophagus aurantii Howard, Insect Life VI, 1894, p. 231.
Prospalta aurantii Howard, Insect Life, VII, 1894, p. 6.
Prospalta aurantii Howard, Revis. Aphelin. N. A., 1895, p. 41. fig. 13.

berlesei How.—♀—Eastern U. S., Italy.

Prospalta berlesei Howard, Entomological News, October, 1896, pp. 291–2, fig.
Prospalta berlesei Masi, Cont. Conoscenza Chalcididi Italiani III, pp. 143–5, figs. 40–43, (1908).

conjugata Masi—♀—Italy.

Prospalta conjugata Masi, Cont. Conoscenza Chalcididi Italiani III, pp. 146–8, figs. 44–46 (1908).

fasciativentris Girault.—♀—Ills.

Prospaltella fasciativentris Girault, Psyche, December, 1908.

fuscipennis Girault—♀—U. S.

Prospaltella fuscipennis Girault, Psyche, December, 1908.

maculata How.—♀—China, California.

Prospalta maculata Howard, New Genera and Species of Aphelininae, Tech. Ser. 12, Part IV, U. S. Dept. Agric., Bur. Entom., (1907), pp. 79–80, fig. 16.

murtfeldtii How.— ♀—U. S.

Prospalta murtfeldtii Howard, Insect Life, VII, 1894, p. 6.
Prospalta murtfeldtii Howard, Revis. Aphelininae N. A., 1895, p. 40, fig. 12.

similis Masi— ♀—Italy.

Prospalta similis Masi, Cont. Conoscenza Chalcididi Italiani, III, (1908), pp. 148–9, fig. 45.

tristis Zehnt.— ♀—Java.

Prospalta tristis Zehntner, Med. V. 2 Proefst. Oost-Java n. s. No. 29, 1896, pp. 11–12, figs. 17–21.

Table of Host Relations.

Parasites.	Hosts.
aurantii	Aonidiella aurantii citrinus (Coq.)
	Diaspidiotus ancylus (Putn.)
	Aspidiotus pini Comst.
	Lepidosaphes beckii (Newm.)
	Lepidosaphes concolor (Ckll.)
	Lepidosaphes eucalypti Crawford MS.
	Chionaspis sp.
	Aspidiotus hederae (Vall.)
	Diaspidiotus juglans-regiae (Comst.)
	Diaspidiotus howardi (Ckll.)
	Lepidosaphes gloverii (Pack.)
	Diaspidiotus forbesi (Johns.)
murtfeldti	Diaspidiotus uvae (Comst.)
tristis	Aleyrodes bergi Sign.
berlesei	Diaspis pentagona (Targ.)
maculata	Lepidosaphes beckii (Newm.)
conjugata	Aleyrodes brassicae Walk.
similis	Diaspidiotus ostreaeformis (Curt.)
quercicola	Aleyrodes gelatinosus Cook.
koebelei	Kermes sp. (males)
fuscipennis	Chrysomphalus obscurus (Comst.)
citrella	Aleyrodes coronatus (Quaintance)
brunnea	Aleyrodes sp. (on climbing vine)
fasciativentris	?Aspidiiotus perniciosus (Comst.)
	?Chionaspis furfura (Fitch.)
	Diaspidiotus forbesi (Johns.)
	Diaspidiotus aesculi (Johns.)
	Diaspidiotus juglans-regiae (Comst.)
	Aspidiotus sp. on Celtis.

TWO NEW SPECIES OF IDOLOTHRIPS.

By J. Douglas Hood, Urbana, Illinois.

Of the two species of Idolothrips to be described below, the former has been known to me for more than two years, but only recently have I recognized it as distinct from I. coniferarum Pergande, which was described in 1896. I regret that I have been unable directly to compare these species, but I have never met with the latter in the field, and have been unable to secure specimens from the original describer.

The value of the antennal sense cones in the definition of species seems to have been first recognized by Dr. Hinds, and in his descriptions, their form, size, and position are usually noted. In view of the value of these structures in specific, if not generic, determination, I have ventured to introduce into the following descriptions a method of recording their positions. The number of the antennal segment is followed, first by the number of sense cones on its inner surface, and then by the number on its outer surface; rudimentary cones are indicated by an exponent preceded by a plus sign. Thus 3, $2\text{–}1^{+1}$ means that on the inner surface of the third antennal segment are situated two fully-developed sense cones, while on the outer surface there is one fully developed and one rudimentary, cone.

Genus IDOLOTHRIPS Haliday, 1852.

Idolothrips armatus sp. nov. (fig. 9; 1, 2, and 3*a*).

Female.—Length about 3.3 mm. Color black; antennal segments 3–5 yellow basally; tarsi blackish brown; fore tibiæ often brownish yellow along middle of inner surface.

Head about two and one-half (2.44–2.64) times as long as wide; narrowest just behind eyes, widest just before the base, and without "neck-like constriction"; dorsal and lateral surfaces finely striate, sparsely set with short, subequal, inconspicuous spines; vertical bristles slightly shorter than the postocular, which are about one and one-half times as long as eyes; vertex conical, produced, apex overhanging insertion of antennæ. Eyes large, prominent, bulging, finely faceted, distance across them almost equal to greatest width of head. Ocelli small; anterior ocellus occupying extreme vertex; posterior ocelli nearly opposite centers of eyes and slightly removed from their inner margins. Antennæ slender, eight-segmented, about 1.4 times as long as head; segments 3–5 clavate; 6 and 7 sub-cylindrical, pedicellate; 8 lanceolate; segments 1 and 2 nearly concolorous with body, 2 slightly paler apically; segment 3 yellow, apical sixth clouded with black; segments 4 and 5 with respectively their basal two-thirds and two-fifths yellow; remainder of antenna concolorous with body; sense cones long, slender, transparent, scarcely distinguishable from the antennal bristles; formula: 3,0–1; 4, 1–2; 5, $1\text{–}1^{+1}$; 6, $1\text{–}0^{+1}$; 7 with one on dorsum near apex, and 3 and 4 each with a sub-apical one on ventral surface. Mouth cone short, broadly rounded, reaching about to middle of prosternum.

Prothorax very slightly shorter than greatest width of head, and (including coxæ) about twice as wide as long, with a prominent median groove; surface faintly reticulate; usual spines all present, the pair at the posterior angles much the longest, nearly as long as the postoculars. Pterothorax sub-rectangular, slightly wider than long, and slightly broader than prothorax; anterior corners projecting slightly beyond the lateral margins. Wings present, short, reaching to posterior margin of sixth abdominal segment. Legs without conspicuous spines; fore femora slightly more than half as wide as greatest width of head; fore tarsi armed each with a short broad tooth.

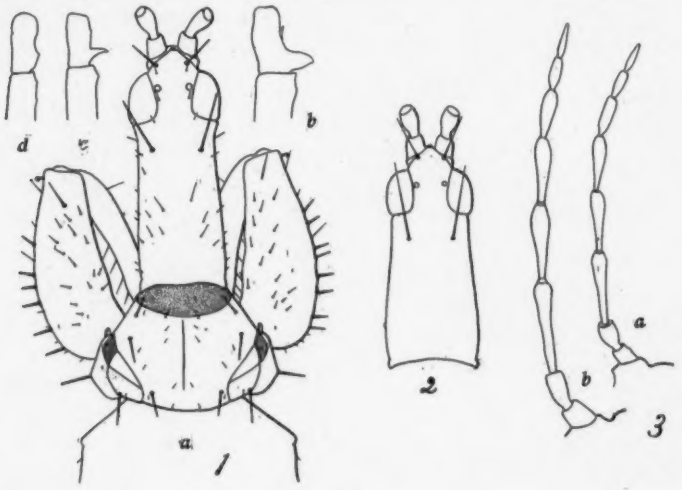

FIG. 9.

1.—Idolothrips armatus sp. nov.; a, head and prothorax, male, x67; b, c, left fore tarsus, male, x93, showing variations; d, left fore tarsus, female, x93. (J. D. H., del.)

2.—Idolothrips armatus sp. nov., female, head, x67. (J. D. H., del.)

3.—a, Idolothrips armatus sp. nov., female, right antenna, x67; b, Idolothrips tuberculatus sp. nov., female, right antenna, x67. (J. D. H., del.)

Abdomen long, very slender, lanceolate, about 1.4 times as wide as pterothorax, and about four times as long as its greatest width; widest at segment 2, thence tapering evenly to base of tube. Tube slightly shorter than head, tapering evenly from base to apex; surface not spinose; terminal bristles much shorter than tube, brown or black at base. Spines on segments 5–8 one-third as long as tube; those on segment 9 nearly as long as tube.

Measurements:—Total length 3.0–3.6 mm.; head, length .56 mm., width .22 mm.; prothorax, length .22 mm.; width (including coxæ) .40 mm.; pterothorax, width .45 mm.; abdomen, width .61 mm.; tube, length .50 mm.; width at base .118 mm.; at apex .059 mm. Antennæ: 1, 53μ; 2, 76μ; 3, 165μ; 4, 140μ; 5, 123μ; 6, 104μ; 7, 73μ; 8, 78μ; total, .81 mm.; width, 42 μ.

Male.—Larger than female (length 3.3–3.9 mm.). Fore tarsi yellow; fore tibiæ yellow along middle of inner surface, becoming concolorous with body laterally and basally.

Head about 2.8 times as long as wide (2.77–2.92), widest across eyes; genal spines inconspicuous, the pair just behind the eyes largest. Eyes larger and

more bulging than in female, the head flaring out to receive them. Antennæ slightly less than 1.4 times as long as head (usually about 1.38).

Prothorax slightly longer than greatest sub-basal width of head. Fore femora usually as wide as, or slightly narrower than, head, armed on basal half of outer surface with about seven prominent, stout, black, and nearly equidistant spines, and on outer surface near apex with a long, stout, downwardly-hooked spine; fore tarsi provided either with a long and very stout straight tooth or with a shorter and much more slender curved one.*

Abdomen more slender than that of the female, slightly narrower than pterothorax, and about five times as long as wide; tapering evenly from base to tube. Tube about .65 as long as head, and excepting a short basal widening, tapering evenly to apex.

Measurements:—Total length 3.3–3.9 mm.; head, length .60 mm., width .218 mm.; prothorax, length .224 mm., width (including coxæ) .45 mm.; pterothorax, width .52 mm.; abdomen, width .51 mm.; tube, length .37 mm., width at base .101 mm., at apex .059 mm. Antennæ 1, 53μ; 2, 75μ; 3, 173μ; 4, 151μ; 5, 136μ; 6, 107μ; 7, 75μ; 8, 78μ; total .84 mm.; width 42μ.

Described from eight females and eight males, all from Illinois, as follows: Carbondale, May 19, June 20, in galls of Gnorimoschema gallæsolidaginis on Solidago canadensis (C. A. Hart, J. D. H.); Havana, June 27, in miscellaneous sweepings (C. A. H.); Pulaski, May 24, in woodland sweepings (C. A. H.); Urbana, Aug. 7, on Plantago rugelii (J. J. Davis).

This species is closely related both to I. africana Trybom and I. coniferarum Pergande. From the former, it may easily be distinguished by the shape of the tube, which is fully four times as long as its greatest basal width, while in africana the tube is "am Grunde ein Drittel so breit wie lang." From coniferarum, of which Dr. Hinds gives four figures, it differs most noticeably in the shape and length of the head, the length of the vertical and postocular bristles, and in the form of the antennal segments. The male of armatus, furthermore, has a strong, hooked subapical spine on the outer surface of the fore femora, in addition to the stout and nearly equidistant spines which have suggested the species name.

Idolothrips tuberculatus sp. nov. (fig. 9, 3*b*; fig. 10).

Female.—Length 3.8–4.3 mm. Color coal black, without markings; antennal segments 3–6 yellow basally; tarsi and apices of tibiæ brown.

Head slightly more than twice as long as wide, slightly narrowed just behind eyes and at extreme base, widest across eyes; dorsal and lateral surfaces finely striate; cheeks with many prominent, stout, black spines, of which a postocular and a sub-basal pair are usually longer; vertical bristles shorter than the postocular, which are about equal in length to eyes; vertex conical, produced, apex overhanging insertion of antennæ. Eyes large, prominent, bulging, finely faceted. Ocelli moderate, their diameter about twice as great as that of facets of eyes; anterior ocellus occupying extreme vertex; posterior ocelli opposite anterior third of eyes and slightly removed from their inner margins. Antennæ slender, eight-segmented, about one and one-half times as long as head; segments

*The size of the tarsal tooth apparently depends upon the degree of enlargement of the fore femora.

3–5 clavate; 6 subclavate; 7 sub-cylindrical, pedicellate; 8 lanceolate; segments 1 and 2 nearly concolorous with body, 2 slightly paler apically; segments 3–6 with respectively their basal two-thirds, three-fifths, two-fifths, and one-third, pale yellow; remainder of antenna dark blackish brown; all sense cones long and slender; formula as for I. armatus sp. nov. Mouth cone short, broadly rounded, reaching about to middle of prosternum.

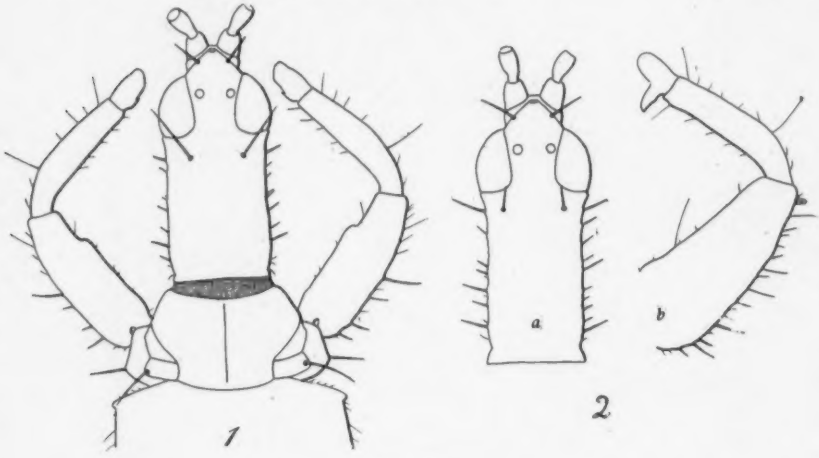

FIG. 10.

1.—Idolothrips tuberculatus sp. nov., female, head and prothorax, x60. (J. D. H., del.)

2.—Idolothrips tuberculatus sp. nov., male, a, head, x67; b, right fore leg, x60. (J. D. H., del.)

Prothorax about as long as width of head, and (including coxæ) about twice as wide as long, with a median groove; surface reticulate; coxal spine and the two notal pairs near the posterior angles, prominent; all others lacking (?). Pterothorax sub-rectangular, about two-thirds as long as wide, and slightly broader than prothorax. Wings large, powerful, closely fringed, and washed with brown at base; principal vein of both pairs extending about to middle; fore wings with a blackish brown area in front of the black anterior vein, with the sub-apical fringe on the posterior margin double for about forty hairs, and with the most distal of the three basal spines fully as long as the prothorax. Inner lower surface of fore femora each with a large prominent semicircular projection; fore tarsi armed each with a short, acute, hooked tooth, the apex directed forwards on a line parallel to the tarsus.

Abdomen large, heavy, lanceolate, slightly wider than pterothorax and about 3.3 times as long as its greatest width; widest at segments 2 and 3, thence tapering nearly evenly to base of tube. Tube slightly shorter than head, tapering evenly from base to apex; surface not spinose; terminal bristles shorter than tube, black at base. Spines on segment 9 about equal in length to tube, brownish; spines on basal abdominal segments short, colorless.

Measurements:—Total length, 3.8–4.3 mm.; head, length .64–.70 mm., width .28 mm.; prothorax, length about .27 mm., width (including coxæ) .55 mm.; pterothorax, width .65 mm.; abdomen, width .75 mm.; tube, length .60 mm., width at base .137 mm., at apex .07 mm. Antennæ: 1, 64μ; 2, 92μ; 3, 224μ; 4, 196μ; 5, 168μ; 6, 115μ; 7, 78μ; 8, 92μ; total, 1.02 mm., width 53μ.

Male.—Larger than female (length about 4.5 mm.). Fore tarsi brownish yellow; fore tibiæ blackish brown, darker basally.

Head longer, narrower, and wider across eyes than that of female; genal spines longer and much more prominent; postocular bristles less than half as long as eyes. Eyes larger, more bulging, the head flaring out to receive them.

Prothorax longer than width of head, less than twice as wide as long; anterior lateral margins broadly and evenly rounded. Inner surface of fore femora without trace of a tubercle; outer surface near apex with a long, stout, downwardly-hooked spine; fore tarsi armed each with a very large, stout tooth.

Abdomen slender, tapering evenly from base to tube. Tube .73 as long as head, tapering evenly from base to apex. Segment 9 with a pair of strong, prominent, downwardly-directed, brown spines on its ventral surface.

Measurements:—Total length 4.52 mm.; head, length .74 mm., width .26 mm.; prothorax, length .35 mm., width (including coxæ) .60 mm.; pterothorax, width .70 mm.; abdomen, width .66 mm.; tube, length .54 mm., width at base .123 mm., at apex .078 mm. Antennæ: 1, 73μ; 2, 98μ; 3–8?

Described from four females and one male, all from Illinois, as follows: White Heath, Aug. 26, 3 ♀'s and 1 ♂, on white oak (C. A. Hart); Bosky Dell, Oct. 22, ♀, on white oak (L. M. Smith).

This species is a very distinct one, readily distinguishable from its congeners by the femoral tubercle and tarsal tooth of the female, and by the armature of the ninth abdominal segment of the male. It is the largest known North American species of the order east of the Rocky Mountains.

Recent Deaths.

William Harris Ashmead, Honorary Fellow of the Entomological Society of America, died in Washington, D. C., October 17th, 1908. Mr. Ashmead has been a tireless worker in entomology and his name will be permanently connected with the science of American entomology, especially in the Hymenoptera, which was the field of his work for many years.

James Fletcher, Entomologist of the Central Experimental Farms of the Dominion of Canada, and one of the best known of American entomologists died in Montreal, Canada, November 8th, 1908. He has been a fellow and one of the active officers of the Entomological Society of America and one of the strongest friends and an ardent supporter of the Annals.

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